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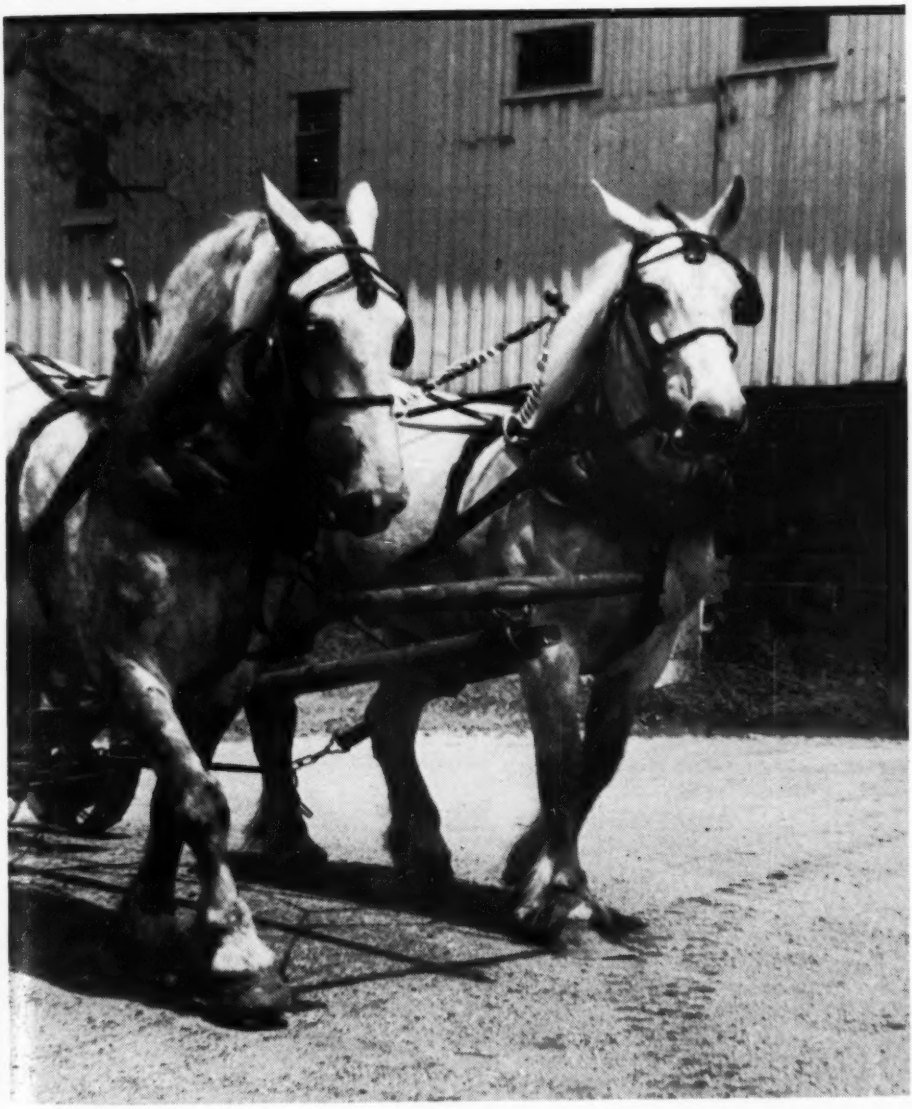

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Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

VOLUME XXXI NO. 3

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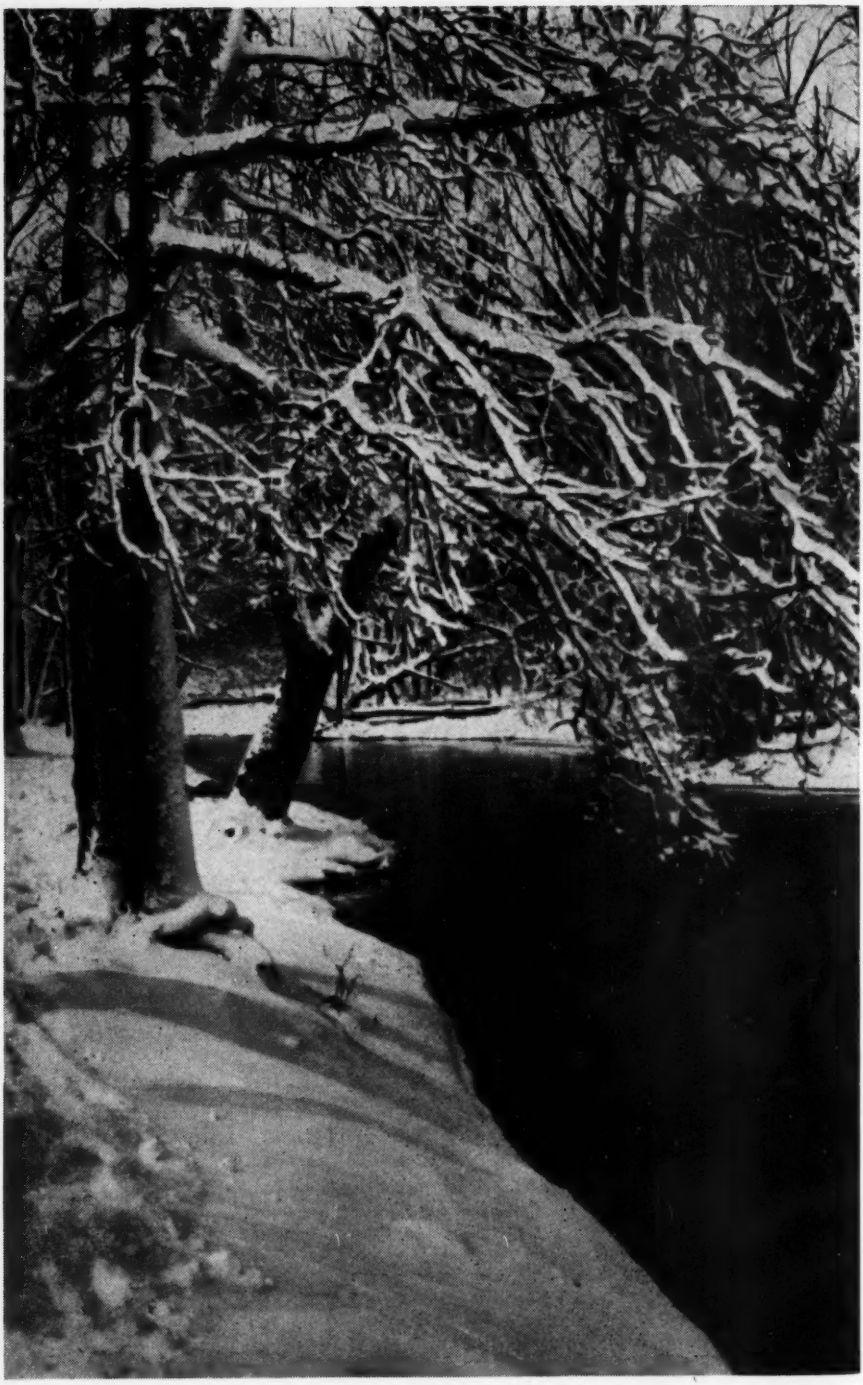

PRECEDING THE BREAK-UP

Better Crops with PLANT FOOD

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Vol. XXXI WASHINGTON, D. C., MARCH 1947 No. 3

Some Judicious . . .

Backtracking

Jeff McDermid

BEFORE trying to fag your brains in attempting to make a wise choice of a farm program to guarantee absolute and unconditional solvency to the ones who grow your grub, it might not be amiss to take a refresher in respect to the steps we took to get where we are and why.

Even though we've lived through all of these economic experiences and written, talked, and heard many things about them, one soon forgets the pains of childbirth or what the doctor cost us. Then, moreover, some of us knew the chief actors in the drama and either sent them flowers after each performance or lambasted them with eggs and cabbages.

Of late, there have been divers worthy feelers put out to test the prevailing spirit of the ruralite anent the particular brand of salvation and relief which he is least apt to snarl about or cast votes against. Little, if any, cognizance is taken meanwhile of the other folks who pay the ultimate bills or who are expected to eat up sundry surplus when the planners happen to guess wrong.

However, far be it from me to take sides in this scuffle or inject any unhappy similes or untoward references which could be interpreted as exhibiting bias or signs of a recalcitrant and reactionary mind. As a matter of fact, your scribe has done yeoman service at the business end of a Remington for three decades, nobly reporting the infinite zeal and unselfish loyalty of the "squash" bucklers who carried the

fight from some obscure point in Iowa to the front pages of the Federal Register. All this, and heaven too, will be his reward!

Let us, therefore, be up and doing, scanning the pages of agrarian history. We begin beyond that plebeian time that we knew so well as kids. In our salad days, about the only forms of government aid on the docket were the sums openly or covertly handed out to old soldiers, big banks, and the railroads.

The banks and railroads had an easy time getting it out of Uncle Sam's wallet pocket, but the indigent veterans of Gettysburg and San Juan Hill had to hire talented galaxies of high-priced legal lights to pry loose some small change in partial remuneration for physical disability.

Then we took on another war in 1917 to bolster our crop of fresh heroes and give the farmers temporary prosperity. During two years of war in Europe we produced food in more abundance than ever before and by 1919 the Secretary of Agriculture acknowledged that the plow had saved civilization again. In much the same manner as today, the rural expectation was whetted to believe in a long period of heavy demand for the grain and livestock which this country could raise—with a few sour notes to mar the jubilant chorus.

THEN in the summer of 1920 agricultural prices began to waver and decline, slapping the war-bloated farmer into a coma just as he loaded up with produce to sell in exchange for mighty likely looking doodads in the mail-order catalogs. What was worse, the prices he had to fork over for factory and store goods stayed up close to the fever pitch of wartime. The farmer thought that a world with tight belts, after severe rationing, would treat him nicer than that. It looked like somebody was pulling shenanigans, and folks who had extended their credit pretty thin in town banks to cover the purchase price of more acreage called the situation indecent, only this was not the exact language used at all times.

This process whereby a yielding yeomanry banged up solid against the rock of rigid buying prices caused two things to happen—death of an old rural regime and birth of the farmers' partnership with government. Not right away quick, you understand, but with the protracted yet potent power commonly seen in the joyful fermentation of a mess of pot-likker.

FACED with old debts contracted under happier times and insulted daily at the market place by meager tithes for their toil, it is no wonder that those days between 1920 and 1924 were the boom era of the so-called farm propaganda organizations.

During the hectic 1920 campaign which put Harding in the front seat, the speeches made in the tall grass in support of price-fixing policies received no echo in Washington. Here the talk was mostly about getting higher tariff fences built, more loans to push foreign exports, more chances to get farmers into debt with easy money, and a frill or two of legal trimming for the newly born cooperatives.

By dint of considerable vocal force and election threats, the boys from back there finally induced the Congress to establish a fact-finding commission of agricultural inquiry, which reported late that season that the pitch-fork element had taken a shellacking. This was not exactly news out West, but it showed that the country was aware anyhow that part of the machinery was in need of grease. Their modest estimate that farmers had only 77 per cent of the buying power which their mazuma had pre-war probably justified clerical costs spent by the commission, but it saved nobody's skin. It is true that the commission ventured a few cautious recommendations, including giving co-ops a legal advantage if possible, a workable system of intermediate credit for farmers, reduced

freight rates, higher rural life standards (if they could be found), and better roads to market. It closed with a pious adherence to the shelf-worn dictum that "interplay of economic forces and not legislative formulas must be sought for in restoring agricultural prosperity."

Applying the panaceas sketched by the conference, Congress extended the life of the War Finance Corporation

with a double-barreled objective—to finance more exports and to make loans to rehabilitate agriculture. The President signed a new and higher tariff rate schedule to "protect" our industry from foreign imports, which set the stage for further maladjustment and grief. Moreover, the first signs of a prolonged crusade were indicated by formation of the so-called "farm bloc" in the House and in the Senate.

Fortunately, there was at the time a new Secretary of Agriculture who had first-hand acquaintance with the plight of agriculture. Against the opinions of some other cabinet members, Secretary Henry C. Wallace talked President Harding into calling the first National Farm Conference, opened with his address reminding farmers that legislation can do little more than give them a chance to adopt more efficient methods and then organize to "help themselves." He little knew how prophetic his last phrase really was, or how efficient farm leaders would become in finding ways to "help themselves" to all that seemed desirable for a fair exchange balance.

This national forum met in Washington almost exactly 25 years ago. Secretary Wallace told them that agriculture was in a bad way, causing suffering and stagnation to the entire business and industrial structure. In true American fashion, the meeting set up a dozen different specialized committees with lengthy reports and recommendations.

While the reports as a whole echoed some of the new ideas then cropping up and revolving around the slogan of "equality for agriculture," they could not get away from old paths of approach to fancied prosperity. They favored higher tariffs, more credit to get rid of surplus in foreign trade, more farm credit, and price stability to be won through broader powers and privileged positions for the farmer cooperatives. But tucked away in some obscure corner of the report were suggestions for a system of crop insurance and requests for government guaranty of farm prices.

PERSONALLY, the writer saw nothing of the national conclave, but numerous side issues and hectic verbal battles came under his ken in the Midwest. It was about this time that Jim Howard tried to get a hearing in Washington and was told to "go home and slop the hogs." It was in this era that the Farm Bureau and the grain and livestock boys formed action committees with ambitious plans galore, and at one big assembly in Chicago we corn-belt scribes listened to the impassioned and lively oratory of Aaron Sapiro, who for a year or more became the Tom Paine of the embittered dairy and livestock crowd, with his shibboleth for taking the initiative through "organizing by commodities.' Only a few old-timers today ever heard of Aaron, who did not last long because he treated the wheel-horses of the farm phalanx with contempt and subjected their theories to open ridicule. The horny-handed wheat and hog bosses of

(*Turn to page* 49)

Fig. 1. The mechanism employed in aerating the jars is illustrated above. A total of eight jars was connected in series and attached by rubber hose to the pump. A total of six such series was employed and each series was aerated two hours per day.

Sugar Beets Require Adequate Soil Aeration

By Floyd W. Smith and R. L. Cook [1]

Soil Science Department, Michigan State College, East Lansing, Michigan

OBSERVATIONS of growth exhibited by sugar beets in field fertility experiments have shown that a leguminous crop in the rotation preceding this crop is less beneficial if unfavable soil tilth and moisture conditions exist at planting time or shortly thereafter. Actual plot yields have verified these observations.

The effects of poor soil aeration on the growth of several crops have recently been reported by several investigators. Hoffer (3) attributes the failure of corn, on certain Indiana soils, to respond to fertilizer treatments to the lack of sufficient soil aeration. Lawton (4) noted that lack of aeration reduced the total absorption of certain nutrient elements by the corn plants on Iowa soils. Farnsworth (1) has noted significant increases in the growth of sugar beets when the non-capillary porosity of a soil was maintained at a level of six per cent or above and has suggested that aeration of the soil is likely to become a limiting factor in sugar beet growth if the air capacity of a soil is below nine per cent.

An investigation to study the effects

[1] The senior author is now Assistant Professor of Soils, Kansas State College, Manhattan, Kansas.

of soil aeration on the growth and yield of sugar beets in pot cultures was recently conducted by the Michigan Agricultural Experiment Station (6). The soil used in this greenhouse experiment was a Brookston clay loam similar to that on which certain adverse effects due to poor soil tilth had been observed in the field. Inasmuch as alfalfa and sweet clover are the two leguminous crops frequently produced immediately prior to the sugar beets in a rotation and since corn is the non-leguminous crop often produced immediately before the sugar beets when the leguminous crop occupies some other place in the rotation, it was decided that any investigation of the effect of aeration on sugar beets should take these factors into consideration. These crops were, therefore, grown before the sugar beets, and following the harvest of these crops the entire plant tissue was finely chopped with scissors and incorporated with the mass of soil in the jar.

Physical treatments were employed in preparing the cultures for sugar beets so as to provide different states of aeration therein. Half of the jars were continued at the moisture equivalent of 25 per cent while the other half were provided with excess water so as to maintain them at 28.2 per cent moisture. Half of the soil from the various cultures was compacted by tamping upon being returned to the jars prior to planting the sugar beets. This compaction process resulted in a volume weight of 1.43 on these cultures as compared to 1.0 on the uncompacted cultures. Artificial aeration was provided for half the cultures by use of the air pump mechanism shown in figure 1. The treatments thus provided included (1) normal, (2) aeration, (3) compaction, (4) aeration and compaction, (5) excess water, (6) excess water and aeration, (7) excess water and compaction, and (8) excess water, aeration, and compaction.

Certain chemical studies were conducted during the growth of the sugar beets. The oxidation status of the soil was investigated by means of the technique described by Hoffer (2). Nitrate nitrogen determinations were made in accordance with the technique of Prince (5).

Certain outstanding facts were apparent as a result of the investigation described above. The effect of lack of aeration on the oxidation status of the soil was clearly illustrated. The accumulation of the objectionable ferrous iron on all of the compacted cultures suggests that the normal oxidation processes were very markedly disturbed. In-

Fig. 2. The top growth of sugar beets for the alfalfa series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

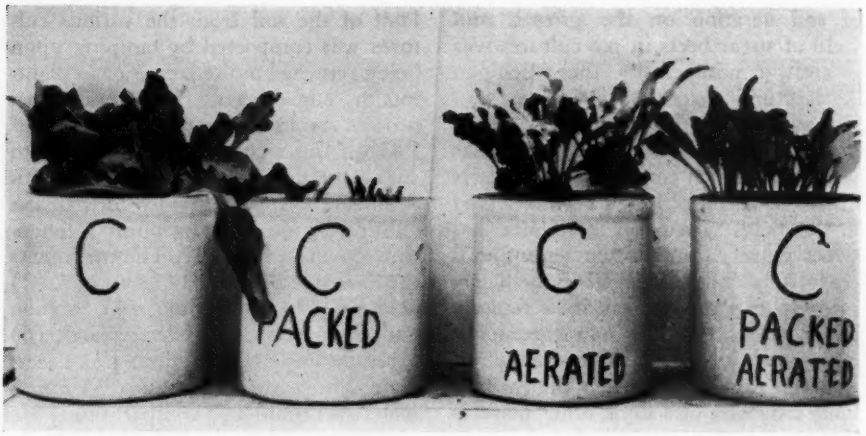

Fig. 3. The top growth of sugar beets for the corn series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

asmuch as the artificial aeration on certain of the compacted cultures resulted in partially eliminating this accumulation of ferrous iron and restoration of the supply of ferric iron, it is readily apparent that insufficient aeration is the cause for such accumulation. Since the artificial aeration treatment did not overcome this tendency on the compacted soils which were subjected to the excess water treatment, it is seen that a minimum effective air capacity as well as an exchange of gas between the soil and atmosphere is essential to the maintenance of the proper oxidation status in soils of this character.

The data presented in table 1 with regard to the nitrate nitrogen content of the soil also serve to illustrate that normal processes within the soil are very much disturbed by limited aeration. The failure of those cultures, which were compacted, to produce a high level of nitrification even after the incorporation of large amounts of nitrogenous material offers some explanation

TABLE 1. NITRATE NITROGEN DATA.

Physical treatment	Mean[1] nitrate nitrogen content for			Series average ppm
	Alfalfa series ppm	Corn series ppm	Sweet clover series ppm	
1. Normal	33.21	2.42	41.94	26.05
2. Aeration	33.42	6.33	62.98	34.92
3. Compaction	2.33	1.29	1.99	1.82
4. Aeration and compaction	2.66	1.67	2.60	2.31
5. Excess water	40.80	4.70	22.16	22.56
6. Excess water and aeration	52.10	2.49	53.94	36.00
7. Excess water and compaction	2.19	.67	2.37	1.74
8. Excess water, aeration, and comtion	1.96	1.19	2.76	1.97
Average for all treatments	21.09	2.59	23.82	15.83

[1] Mean of four replicates.

Fig. 4. The top growth of sugar beets for the sweet clover series at the time of harvest is illustrated above. Treatments from left to right are: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

as to why a preceding legume crop may be ineffective in stimulating sugar beet yields under field conditions when there exists the presence of excess moisture and a state of poor tilth, either alone or in combination. It may also be observed in table 1 that artificial aeration partially restored normal nitrification processes but not entirely so. This, as did the evidence pertinent to the oxidation status of the soil, suggests the desirability of maintaining a maximum effective air space in the soil for the production of sugar beets.

The effect of the various physical treatments on the yield of sugar beet roots presents itself in a striking manner in table 2. Comparative good and uniform yields of sugar beet roots were obtained as a result of any physical treatment of the soil considered herein and succeeding either corn, alfalfa, or sweet clover so long as this treatment did not involve compaction. Slight

TABLE 2. YIELD OF SUGAR BEET ROOTS.

Physical treatment	Mean[1] dry weight of sugar beet roots for			Series average grams
	Alfalfa series grams	Corn series grams	Sweet clover series grams	
1. Normal	16.75	17.93	11.88	15.45
2. Aeration	17.00	17.80	18.23	17.68
3. Compaction	.88	2.23	1.18	1.43
4. Aeration and compaction	6.04	7.07	2.47	5.19
5. Excess water	16.18	13.90	19.18	16.42
6. Excess water and aeration	17.95	19.20	19.98	19.04
7. Excess water and compaction	.18	.16	.37	.24
8. Excess water, aeration, and compaction	2.06	1.49	1.98	1.84
Average for all treatments	9.61	9.97	9.40	9.66

[1] Mean of four replicates.

increases in yield were obtained where additional water and air were provided uncompacted soils, especially on those cultures where the preceding crop was sweet clover. Additional water, without artificial aeration, on a soil which was not compacted was slightly detrimental on the culture which had previously produced corn. However, these minor variations suggest that aeration on a soil which is not compacted and which has an air capacity of over 30 per cent is not likely to become a limiting factor in the production of sugar beets.

Compaction of the soil, following all crops, resulted in a considerable reduction in the yield of sugar beets. This reduction was evidenced both in root and top growth, as indicated in tables 1 and 2, respectively. The reduction in the former was of considerably greater magnitude, however, as is indicated by a consistent decline in the ratio of roots to tops on those cultures which received compaction. The effect of compaction on the soil was more serious than the addition of excess water as applied in this experiment. This observation was not surprising inasmuch as compaction alone resulted in the disappearance of much more of the original air capacity of the normal soil than did the addition of the excess water. The fact that the application of excess water alone resulted in slight stimulation of yields suggests that normal aeration is not a limiting factor on the uncompacted soil. That additional water may, under certain conditions, be highly detrimental is demonstrated by its addition to the compacted soil.

Proof that aeration was a limiting factor in the growth of sugar beets on the compacted soils is offered by the stimulation of yields as a result of artificial aeration on the compacted soil. The fact that stimulation was less on the compacted soil with excess water present can be explained on the basis of the extremely low effective air capacity. It is interesting to note that marked stimulation resulted from this artificial aeration treatment on all of the compacted cultures which did not receive excess water and it is especially interesting to note that this stimulation was very marked on the cultures which previously had produced corn. This treatment on the cultures following the growth of corn resulted in a yield more nearly approaching those from the uncompacted soil than did any other treatment on any series. This fact adds to evidence already presented as

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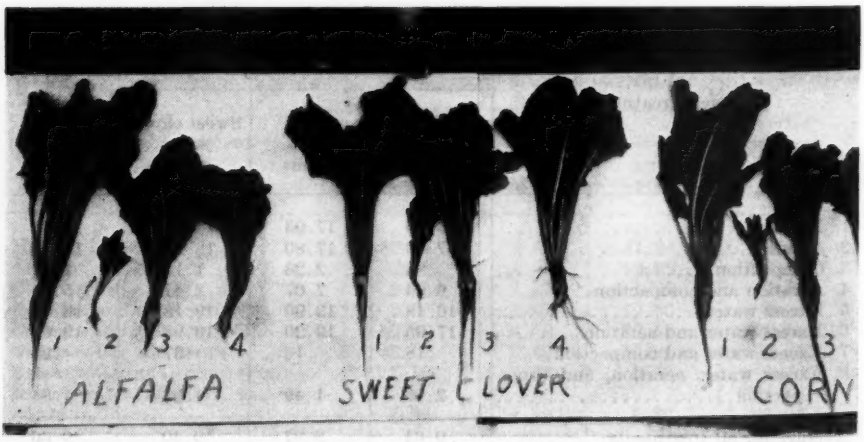


Fig. 5. The relative growth of representative sugar beets within the various cultures is illustrated above. Treatments represented by the beets are as follows for each of the series—alfalfa, sweet clover, and corn: (1) Normal; (2) compaction; (3) aeration; and (4) aeration and compaction.

The Role of Major Elements in Plant Nutrition

By L. D. Davis

Department of Pomology, University of California, Davis, California

ANY discussion of the internal factors associated with the development of plants will nearly always include the essential elements and the part they play, just as it would probably include a discussion of some phase of their water relations, their translocation problems, the mechanism or channels involved, the problem of respiration, the phenomena of growth and in recent times that of the growth promoters.

The discussion of the elements necessary for plant growth is probably not so simple and straightforward as it once was and, I suspect, the role of each cannot be stated so conclusively. It has been almost a hundred years (1844, according to Brenchley) since the first paper was published describing deficiency symptoms and calling attention to the essential nature of certain elements for plant growth. This first element was, as might be suspected, iron, since its lack is so striking. For a number of years (by 1860) the technique of growing plants in solution cultures from which one element was omitted had developed so far that it was considered that 10 elements were necessary for plant growth. These 10 were carbon, hydrogen, oxygen, nitrogen, magnesium, iron, sulfur, calcium, phosphorus, and potassium. These investigations were repeated and verified so often that these 10 came to be recognized as the essential elements, even though it was known that a number of other elements were to be found in plants by analysis.

In 1915 Mazé published a paper showing that other elements besides these 10 might be necessary, but so well-grounded was the belief in the 10 that it was another 10 years before there was acceptance of the fact that the 10 might not be all that were needed for normal growth. This situation raises the question of what might be a criterion by which the indispensability of an element would be judged. A basic concept would probably be as follows: "Necessity of an element for normal plant metabolism is demonstrated only if lack of it can be shown to result in injury, abnormal development, or death." The hub of this concept lies in the "lack" of an element. Under our present concept of technique this means that the plant must be grown in some sort of culture solution from which the element in question has been eliminated or reduced by the most refined methods. Modern investigations have recognized the difficulties associated with eliminating an element from culture solutions and have suggested certain previously unrecognized sources of error in the older experiments: (1) Many of the "pure" chemicals used contained, at least, traces of other elements which may have been sufficient to supply the plant with its needs; (2) the elements stored in the seeds were not usually considered in these experiments and sufficient amounts of an element might be contained here for normal growth; and (3) certain elements may dissolve from the walls of the containers in which the plants are growing or in which the reagents are stored.

A failure to place emphasis upon the "lack" of an element is shown by some investigators who have noted increased growth when an element has been added to a complete culture solution.

By such a procedure there have been many elements reported as increasing plant growth and the assumption made that they were therefore necessary. Such a condition may, however, fall short of proof that such an element is necessary for growth; it may only alter some characteristic of the solution making it more favorable for growth of the plant. Furthermore, before the necessity of an element for green plants has been proved it should be shown necessary for a number of species.

Using the critical concept indicated above there are probably 14 or 15 so-called essential elements for plant growth, even though as many as about 40 have been found in plants on analysis and one writer has suggested that the whole periodic table may be found when proper techniques have been developed.

To recapitulate: Our original concept of the elements necessary for plant growth obtained by the technique of solution culture was so well-founded that it wasn't seriously challenged for more than 50 years. The change in concept has been in the nature of additions rather than revision, occasioned by improved technique and an understanding of the very small amounts necessary. The current concept would suggest that the list might keep growing as additional and more critical investigations were made.

A number of ways of classification of these necessary elements are possible, none of which are wholly satisfactory. The following classifications are representative of the attempts that have been made:

1. According to their source; C, H, O coming from the air and water, the remainder of the elements from the soil.

2. According to their ashing properties, C, H, O, N being lost on burning, the others remaining in the ash.

3. According to their supposed function:

a. energy exchange group—H, O

b. energy storers—C, N, S, P

c. translocation regulation—K, Ca, Mg

d. oxidation reduction regulators—Mn, Fe, Zn, Cu.

4. According to the amount necessary for growth—the major and minor (micro, trace), elements.

It can be seen that none of these classifications is entirely satisfactory. The first two are strictly artificial and give no indication of the role of the elements. The third is a more nearly rational one but the difficulty lies in exactly cataloguing an element so that all its functions lie in that group. It omits entirely the function that some element may have in some building structure or in a compound. The last classification is perhaps a more desirable one for our present thinking, especially if the emphasis is placed upon the historical or developmental aspect. It scarcely seems wise to lay too much emphasis upon the relative amounts needed by the terms "major" and "minor." Certainly "major" and "minor" cannot be taken to indicate degrees of indispensability since I assume there is no such thing. They are indispensable or they are not!

Possible Functions of the Elements

The elements needed by plants may subserve a number of functions. Among them are the following:

1. Some of them are component parts of the cell structure such as the cell wall or of the protoplasm. The amount of the different elements used for these purposes may be relatively large, and any deficiency of them is soon noticed in the general growth of the plant.

2. As sources of energy for the varied functions.

3. As influencing elements.

a. on osmotic pressure of cells

b. on acidity and buffer action

c. on hydration of the cell colloids

d. on permeability of cell membranes

e. as antidotal or antagonistic agents

f. as carriers of other ions

g. as catalyzers of reactions.

Role of the Specific Elements

It is not always easy to assign a specific role to an element and feel certain that its sole function lies here. When an element forms an integral part of some building material or compound whose function is known, and whose lack in a culture solution does not result in irregularities other than those expected of this building material or compound, then the role is rather easy to assign. But frequently the lack of an element will result in abnormalities that cannot be simply explained.

All of the 10 major elements have been shown to be necessary to the growth of trees under controlled conditions. The symptoms of a lack of an element are in general the same for trees as for other experimental plants. Primarily, I assume, because of the ease of manipulation nearly all the work in exploring the role of the elements has been done on plants other than trees. What will be said regarding the role of each will therefore be the result of investigations on other plants, but it may be a fair assumption that they would play the same role in trees.

Carbon, Hydrogen, Oxygen (C), (H), (O)—These three are constituents of a very large proportion of all the materials in a plant. They serve:

1. As part of the cell structure in the cell wall and protoplasm.
2. As energy materials—carbohydrates, fats, oils.

In trees the primary energy material is usually in the form of carbohydrates. These may be broken down into those used (a) for current use and (b) for storage.

For our discussion three carbohydrates may be considered as furnishing the bulk of those for current use. These are the sugars—glucose, levulose, and sucrose. All three are water-soluble and serve as the sugars that are translocated from one part of the plant to another. The first two of these, glucose and levulose, have the power of reducing certain compounds and are therefore spoken of as reducing sugars. Sucrose does not have this power of reduction and is therefore spoken of as a non-reducing sugar. In the literature dealing with the metabolism of trees, reducing sugars refers primarily to dextrose and levulose, non-reducing to sucrose, and total sugars means the sum of all three. In trees, the chief storage carbohydrate is starch. This material breaks down into glucose when hydrolyzed by dilute acids or by enzymes. It can, therefore, be considered as a condensation product of a number of molecules of glucose. An additional carbohydrate, hemicellulose, occurs in trees and vines and is said to be a reserve storage product. It yields reducing substances when hydrolyzed by dilute acids; in this case, however, a mixture of sugars results, glucose mixed with two five-carbon sugars, xylose and arabinose. There is considerable controversy regarding whether or not hemicellulose is a storage material. We can, perhaps, best leave it by saying that it does occur in varying quantities in trees and that investigators are not agreed about its function.

Nitrogen (N)—As a component of the proteins and therefore of the protoplasm, this element has a role in which a lack is very readily visible by reduced growth and a lack of green color. Nitrogen is also a part of the chlorophyll molecule.

Iron (Fe)—This element is necessary for the synthesis of chlorophyll, although it doesn't enter into the chlorophyll molecule. The state of the iron in the plant is important, an abundance may be present yet not be in an available form. Such a condition exists in our lime-induced chlorosis. Iron is also supposed to act as a catalyst or oxygen-carrier in oxidation-reduction processes occurring in living cells. The proportionate amount of this element in plant tissues is low, much of it in organic compounds. It is one of the most immobile of the elements, no appreciable redistribution ever occurring from one tissue to another. Hendrick-

son has observed that chlorotic pear leaves sprayed with iron sulfate became green under a drop of spray but not in adjacent areas not wet by the spray.

Magnesium (Mg) — Magnesium forms a part of the chlorophyll molecule and as such is necessary in green plants. When lacking, characteristic chlorosis and perhaps bronzing occurs. Unlike Fe, Mg is readily redistributed from older to younger parts of the plant. Mg is also believed by some workers to be associated with the synthesis of oil and nucleo-proteins in plant cells. Many cases of Mg deficiency have been reported under field conditions.

Calcium (Ca)—A large proportion of the Ca in most plants is located in the leaves. Very little redistribution ever takes place. The Ca content of leaves constantly increases throughout the season. This element apparently plays a multiple role in plant metabolism. (a) It is a constituent of the cell wall as Ca-pectate in the middle lamella. (b) It may influence the permeability of the cytoplasmic membrane. It has been found that plants growing in Ca-deficient solutions may lose ions to the solution, whereas in solutions above a certain concentration of Ca accumulation occurred. (c) It may serve as a neutralizer for certain organic acids, especially oxalic or as an antidoting agent for other ions. (d) It may serve as an aid in translocation of carbohydrates. In absence of Ca starch has been observed to accumulate presumably due to lowered diastatic activity. In culture solutions lacking Ca there was a severe stunting of growth, and almost total failure of roots.

Sulphur (S)—S is a constituent of the amino-acid cystine, which in turn is one of the compounds from which many plant proteins are made. It is also a constituent of glutathione, a compound supposed by many investigators to play a part in the respiration process. Although the exact role is not known, at least one case of deficiency has been reported, that of tea yellows.

Phosphorus (P)—This element apparently plays both a direct and an indirect role in the plant's metabolism. It forms a part of various organic compounds such as the nucleic acids and the phospholipids (lecithin). Deficiency of P interferes with the synthesis of these compounds and hence may interrupt normal cell division. In addition, P acts as the co-enzyme of zymase, seems to exert an accelerating effect on other oxidizing and reducing enzymes and seems to be necessary for hydrolytic transformations of carbohydrates. This element occurs in the greatest abundance in young meristematic cells and in seeds. It is apparently readily redistributed in plants from one part to another.

Potassium (K)—Unlike the other major ash constituents K is not definitely known to be built into organic compounds of fundamental physiological significance. A large proportion of the K in plants is in a soluble form and seems to be readily translocated from one part to another. Relatively large quantities, compared to some of the other ash elements, seem necessary to avoid serious injury. Since it is not used in the construction of some vital cell constituent, it must play a regulatory or catalytic role. The following processes seem to need K for their normal maintenance: (1) The synthesis of simple sugars and starch; (2) translocation of carbohydrates; (3) reduction of nitrates; (4) synthesis of proteins, particularly in meristems; and (5) normal cell division. These conclusions are based upon such experiments as those of Russel for mangolds where 7,255 pounds of leaves produced 14,684 pounds of root in a K-deficient soil, whereas 8,508 pounds of leaf produced 40,128 pounds of root in the same soil that had been supplied with K. Or the experiments of Nightingale in which sugars accumulated in K-deficient plants because N-assimilation had been interfered with. In Spirogyra, normal nuclear division failed to occur in the absence of a potassium supply.

Center—no potash.

Recent South Carolina Studies on Potash with Cotton

By A. B. Bryan

Extension Service, Clemson Agricultural College, Clemson, South Carolina

THE economic significance of the cotton crop in the South emphasizes the desirability of research studies on more efficient production and processing of cotton as well as wider utilization of the cotton fiber, Dr. H. P. Cooper, director of the South Carolina Experiment Station of Clemson Agricultural College, said recently.

This great economic significance of cotton is explanation and justification for great and continuous attention and effort which Clemson research agronomists, including Dr. Cooper, himself an able and well-known soil scientist, have given to the study of cotton production for many years.

Some of the most recent research on cotton production in South Carolina has had to do with the influence of potash with and without limestone; residual effects of potash; best rate and time of applying potash; comparative yields from potassium chloride and sodium chloride; and the effect of sodium on different levels of potash fertilization.

The accompanying table shows what happened to the yields of cotton when potash was applied to cotton with and without dolomitic limestone. The tests, made on Norfolk sand at the Clemson Sandhills branch experiment station, have covered a period of 13 years through 1944.

The basic fertilizer treatment of these test plots consisted of 640 pounds of a 5-10-5 per acre and 50 pounds of K_2O. One half of each plot received 1,500 pounds of dolomitic limestone per

Treatment	Condition of soil	Average yield pounds seed cotton per acre	Increase from lime	
			Lbs.	Per cent
No potash	Unlimed	102	−4	−3.9
	Limed	98		
With potash	Unlimed	717		
	Limed	882		

acre in 1931 and 1,500 pounds more in 1935.

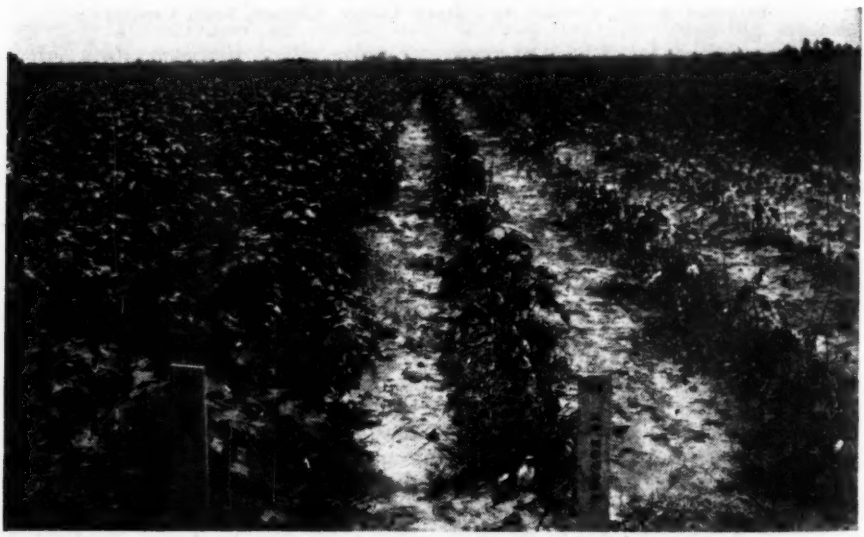
Dr. Cooper's report on the tests shows that the average yield for 13 years (no data for 1941 because of crop failure) was very low on plots that did not receive potash, 102 pounds of seed cotton per acre from the unlimed plots and 98 pounds from the limed plots. It is explained that the slightly lower yield from the limed plots was doubtless due to the generally accepted idea that the addition of calcium in the form of limestone decreases the solubility and the availability of the potash in the soil.

The average increase in yield from the use of limestone was 23 per cent. The range in the percentage increase for the different years was from 0.4 to 48.6 per cent. The greatest increase seems to have occurred in the years of higher total production.

How Much Potash, and When, for Cotton

Further evidence and more direct evidence on the importance of potash are to be found in the tests by Clemson agronomists on rate and time of applying potash to cotton. These tests on how much potash is most economical and what is the best time to apply it date back to 1931 also for their beginning and therefore offer some conclusive evidence.

They show, first, that there were increases of 16 to 25 pounds of seed cot-



Left: 600 lbs. of 5-10-5; right, 600 lbs. of 5-10-0. Both sections were side-dressed with 15 lbs. of nitrogen.

ton per acre for each pound of potash applied as a fertilizer.

They showed, second, that there was little difference in the yield of seed cotton from potash applied at different times.

In these tests all plots received a treatment equivalent to 600 pounds per acre of a 5-10-0 fertilizer mixture before the crop was planted and 15 pounds of nitrogen from calcium nitrate, Cal-Nitro, or ammonium nitrate applied as a side-dressing. In addition, potash was applied at the rates of 0, 15, 30, 45, and 60 pounds per acre, which with the basic mixture were equivalent to 600 pounds per acre of a 5-10-0, 5-10-2.5, 5-10-5, 5-10-7.5, and 5-10-10 fertilizer, respectively.

The average results for 13 years show that the yields became larger as the amount of potash in the fertilizer was increased. The average yield for the plots not receiving potash was 522 pounds per acre. The average yields from the plots receiving 15, 30, 45, and 60 pounds of potash per acre were 903, 1207, 1338, and 1478 pounds of seed cotton per acre, respectively.

These yields represented increases of 381, 685, 816, and 956 pounds over the plots which did not receive potash. It should be noted that these plots did not receive any sodium in the fertilizer. It has been observed that where considerable quantities of sodium are included in the fertilizer there is less response to the use of potash, particularly at the higher rates of application.

The average results of these tests are shown in the following table.

Residual Potash and Yields

That a soil low in available potash suffers only relatively small losses of potash if the cotton stalks and leaves remain on the soil is clear from experiments .conducted at the Sandhills branch station since 1932.

This experiment was started to determine the residual effect of applications of potash on cotton production. Muriate of potash was applied broadcast at the rates of 100, 200, and 400 pounds per acre on Norfolk sandy loam. Six hundred pounds per acre of a 7.5-10-0 fertilizer were applied annually to all plots but no potash has been applied since the original application in 1932.

Results from the 12-year-test, 1932-1944 inclusive, show there were increases in the yield of seed cotton over no potash of 45, 77, and 105 per cent from 100, 200, and 400 pounds of muriate of potash per acre, respectively. These data indicate the efficiency of the cotton plant in the utilization and conservation of fertilizer nutrients. The effects of an application of 100 pounds of potash were very significant after a 12-year period.

Effect of Sodium with Potassium

Another interesting phase of these 13-year tests in cotton fertilization has to do with the comparative yields of cotton from the use of sodium chloride and potassium chloride. In the wording of the report by Dr. Cooper and his associates—

"These data suggest that the addition

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Pounds of potash applied	Average for each rate, pounds	Increase over preceding similar treatment, pounds	Increase over no potash		Increase in seed cotton for each pound of potash, pounds
			Lbs.	%	
None	522				
15	903	381	381	73	25
30	1,207	304	685	131	23
45	1,338	131	816	156	18
60	1,478	140	956	183	16

Thousands of acres of poor, weed-infested, overgrazed, and nitrogen-starved pastures such as this one could be improved by "renovation." This program of rejuvenation calls for liberal treatment with lime and fertilizers, thorough seedbed preparation with the disc, spring tooth harrow, or field cultivator, and then a liberal seeding with clovers, alfalfa, and brome grass.

Efficient Management For Abundant Pastures

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

GOOD PASTURES! These two words bring to our minds a picture of lush fields of palatable, green, succulent forage. That is the kind of pasture that makes milk and meat. Dairy cows that can fill their paunches in two hours on good pasture and then lie down and chew their cuds the next two hours will come in at night with a pail full of milk for their owners.

Too much of our pasture is thin and sparse, in fact is little more than open-air exercising grounds for our dairy herds. Cows that have to hustle and rustle all day to fill their stomachs are not able to convert much of their feed into milk or meat.

In spite of all the talk about pasture improvement during the past 10 years, we do not see very many really good pastures as we travel over the country. Isn't it true that the average farmer has devoted about 90% of his time and energy toward the production of crops on his cultivated fields? We have made real progress in this matter of liming and fertilizing our cultivated crop land. Farmers are sowing and planting all of the new high-yielding varieties of grain and corn. The new rust—and smut—resistant oats, including Vicland, Tama, Clinton, Bonda, Benton, and Eaton are now being grown extensively on farms in the Midwest. Our

Wisconsin Blackhawk and Henry wheats have been bred for disease resistance and higher yields. Hybrid corn, in all conceivable genetic crosses, has been bred for higher yields and resistance to lodging and diseases.

The average farmer, I say, devotes 90% of his time and energy to the production of cultivated crops. He fits and fertilizes his crop land in the spring, sows his seed, cultivates his crops, then harvests and stores these crops in his barns and granaries. In turn he "chores" all winter in converting this feed into milk and meat. But when spring comes most farmers turn their cows out on what has always been just taken for granted—permanent pasture! A few farmers have made a start in the renovation of their old permanent grassland pastures. Many farmers are providing some rotational pasture and every year use a certain portion of their legume acreage for pasture. Some farmers are growing an acreage of sudan grass or other emergency crops for mid- and late-summer grazing.

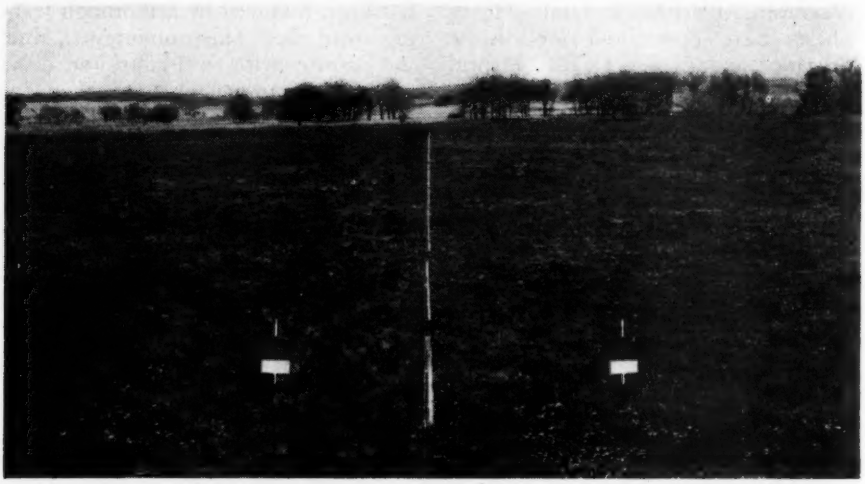
Renovation Recommended

We have talked and heard a lot about renovation in the past few years. The writer suggested this program to farmers in Wisconsin as early as 1923. In the past 25 years I have had an opportunity to see first hand the thousands of acres of weed-infested, thin, poor, and unproductive pasture land. In talking with the owners of these farms as we walked over their pastures, I tried to describe to them the opportunity for pasture improvement by the way of more abundant crops of drought-resistant legumes. Sweet clover for these pastures was so much a part of my vocabulary in the early days that I was nick-named "Sweet Clover Chapman." As I read over these early recommendations for pasture improvement way back in 1922, '23, and '24, I find that I was suggesting about the same procedure that is now being advocated in our present-day renovation program: namely, liberal applications of lime and fertilizer, followed by a thorough tearing-up of these old grub-infested, thin sod pastures with field cultivator, disk, or spring-tooth harrow, and then reseeding with sweet clover and pasture grass mixtures.

About the only change in this so-called renovation program as now advocated is the inclusion of brome grass and ladino clover. Pasture specialists who have in recent years given so much time to the study of pasture improvement by renovation now recommend plowing instead of disking or surface fitting where it is possible to plow. They now recommend the inclusion of a light seeding of oats with the grass seed mixtures where fields are being fitted either by surface cultivation or by plowing.

Pasture improvement by renovation is the number one program we all recommend for the conversion of these thousands of acres of thin, poor, weed-infested, permanent pastures to lush and abundant fields of clovers, alfalfa, ladino, and brome. True the cost per acre in terms of cash and labor is rather high. It means the fencing out of these pasture fields for a period of three or four months while the seedings become well established. And this means the loss of part of a farmer's pasture for the months of May, June, and July. However, it is frequently possible to turn cows into these renovated pastures by the middle of August and graze them lightly up to the middle of September or later.

Dairymen who will follow out this program of renovation and do the job right will be richly rewarded. The second year following renovation is when a farmer really "cashes in" with four to five times as much feed from a given acreage. But we know that sweet clover and alfalfa and other legumes seeded in these pastures will eventually "peter out"; the grasses—brome, timothy, red top, and June—will again take over. And at this point I wish to suggest another great opportunity, as I see it, for pasture improve-



This 23-acre pasture on the Wells Himsel farm at Paoli, Wisconsin, was divided in equal halves with an electric fence in April 1945. The left half received an application of 200 lbs. of ammonium nitrate per acre. The entire herd of dairy cattle was rotated back and forth during the grazing season and a record kept of the pounds of milk produced from each half. When the final records were tabulated, the fertilized half had produced 29,899 lbs. of milk and the unfertilized portion 16,678 lbs. The increase—13,221 lbs. at $3.25 per cwt.—was worth $429.68. The cost of the fertilizer was $48.

ment. It is the story of pasture improvement through the use of nitrogen fertilizer.

Nitrogen, a Source of Protein Feed

Eighty per cent of the air we breathe is nitrogen and yet not an ounce of it is available to man or beast in this elemental form. Where combined with oxygen in the form of "fixed nitrogen" this element becomes an important plant-food nutrient which can be utilized by plants in the synthesis and building of protein. We, of course, all know that the family of legumes is endowed by nature with the power to convert elemental nitrogen of the air into protein. This is accomplished through the action of bacteria working within the nodules which develop on the growing roots of these legumes. We inoculate our clover, alfalfa, peas, beans, etc. in order to be sure that a good strain of the right kind of nitrogen-fixing bacteria is present in the soil in contact with the seed. But the non-leguminous crops including the grasses, corn, cereals, and most vegetable crops must secure their nitrogen from the soil. An abundance of nitrogen results in the lush, dark green, rank growth of these crops, that is, providing adequate supplies of the other elements of plant food are present and growing conditions are favorable.

The supply of nitrogen in our cultivated crop land should be largely maintained through the growing of legumes in the rotation. The feeding of these legumes and the return of manures produced to our cultivated fields add further to the nitrogen supply in our soils. But on much of our crop land in the Midwest we have been "cashing in" on the nitrogen and organic reserves of our soils. This has taken place over the period of 50 to 100 years we have cropped these soils. The available reserves of nitrogen and organic matter are "petering out" on thousands and thousands of acres where the combined effect of erosion and legume failures have left these fields in a nitrogen-starved condition. Farmers can, however, maintain a fairly adequate level of nitrogen in their cultivated fields by the growing of legumes in rotation. The plowing under of clovers, soybeans.

and even crops of non-legumes such as timothy, brome, and other grasses, or cereal crops is recommended from time to time as a means of maintaining the organic matter reserves in our crop land.

Sources of Nitrogen for Permanent Pastures

But what about our permanent pastures? What is the source of nitrogen here? Very few farmers apply stable manure to their pastures. It is true that the native white clovers and other legumes do supply some nitrogen to native grasses. Lespedeza in latitudes 100 miles south of Wisconsin is an important pasture legume that is now being grown as a companion crop with pasture grasses. Not only do these legumes supply protein feed, but indirectly do supply some nitrogen to the pasture grasses as the roots and nodules of these legumes decay. We know, however, that in Wisconsin—in fact it is true in other Midwestern states—that white clover and other natural legumes are fickle and not too dependable. They do not supply sufficient amounts of nitrogen to make possible the abundant growth of our grasses.

A small amount of nitrogen is added each year in the rain-waters. In the virgin state, where our prairies had built up a good reserve of humus and organic matter and where legumes flourished, the nitrogen supply was a sort of revolving fund. When we started the practice of heavy grazing, the reserves of nitrogen and organic matter were gradually reduced. Evidence of this lack of nitrogen is seen on pastures in the spring where those dark green patches of lush grass are so much in evidence. These urine spots in our pastures are good demonstrations of this almost universal lack of nitrogen.

Nitrogen fertilizers have been used by European farmers in pasture improvement for many years. In our own country particularly in the eastern states, the top-dressing of grassland pastures in the spring with nitrate, cyanamid, or ammonium sulphate had become an established practice prior to World War II. This war has given us an additional capacity for the produc-

Here is a renovated pasture on the Aldis Arnsmeier farm at Darlington, Wisconsin. This picture was taken in August of the same year it was seeded. A liberal application of lime and fertilizer (0-20-20 at 400 lbs. per acre) was applied before working up the seedbed in the spring. Alfalfa and red clover made a luxuriant growth and the field was ready for grazing by late August.

tion of nitrogen fertilizers in this country. A total of some nine large factories were built for the production of synthetic ammonia. In fact, four synthetic ammonia plants were built in Canada. During the war these plants turned out vast quantities of ammonium nitrate and other nitrogen compounds which were used in the manufacture of explosives. Strange as it may seem, this same ammonium nitrate and other nitrogen compounds used during the war in the manufacture of gun powder for the killing of men and the destruction of property can now be used as a fertilizer to produce protein feeds. This increased capacity for the production of synthetic ammonia in this country looms up as a new and great opportunity in our potential capacity for the production of food and fiber.

When fertilized with nitrogen, early pasture grasses have been found to contain from 18 to 22% crude protein on the dry matter basis. Not only is this early pasture grass rich in digestible protein, but it is also rich in the minerals and vitamins so essential to a well-balanced ration. Well-fertilized pasture grass when three to five inches in height compares favorably in feeding value with bran, pound for pound, on the dry basis.

One pound of nitrogen applied as fertilizer to grass, if all recovered, would produce about six pounds of grass protein. Under favorable soil moisture conditions it is possible to recover in the form of protein feed about 75% of the nitrogen applied. On this basis, an application of 100 pounds of ammonium nitrate carrying 33 pounds of nitrogen would produce about 150 pounds of crude protein. This is equivalent to the protein contained in 1,000 pounds of bran containing 15% protein. Therefore, 100 pounds of ammonium nitrate costing about $3.00 applied to good bluegrass pasture could reasonably be expected to produce the feed equivalent to 1,000 pounds of bran which at $50 a ton has a value of $25.00.

If rainfall in the spring is insufficient to make possible the conversion of all this nitrogen, it normally remains in

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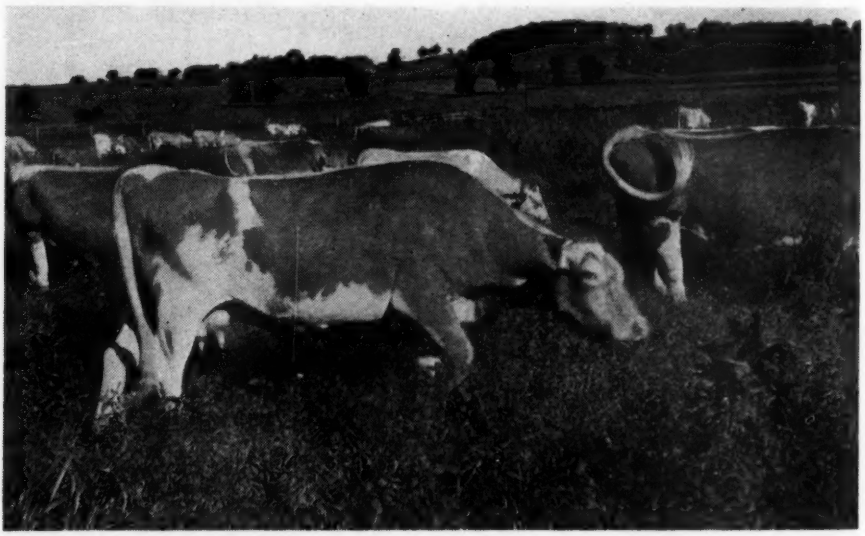

Dairy cattle belly deep in renovated pasture of the Hoard's Dairy farm at Ft. Atkinson. This pasture was plowed, fertilized, and reseeded with a mixture of alfalfa, red clover, and brome grass.

Increased Quality of Products Is Answer to the Problem

By Charles H. Gould

County Agent, Camden, New Jersey

I AM looking at this problem from the standpoint of the increased production of quality products.

It has been repeatedly pointed out that quality products must be offered if our New Jersey farmers are to meet the competition from other areas. This competition is becoming increasingly evident. To be sure, many constructive sales measures have been taken, and more will be taken in the near future, to uphold the dignity of New Jersey farm products on the market. But these marketing programs will not be effective unless quality crops are grown. I believe fertilizer is an important factor in the production of top-grade fruit and vegetables, grain and hay, and pasture.

Much of the argument in favor of the use of fertilizer is focused on the attendant increase in yield. Increased yield and quality go hand in hand; therefore, use more fertilizer and better quality will follow, other things being equal. True to an amazing degree!

I travel over the county and see corn plants with scorched edges and marginal leaf burn, the sign of potash deficiency; in another field, the purplish tinge showing low phosphorus. I see sweet potato fields with peroxide blonde foliage—starving for either nitrogen or magnesium. I see tomato fields that need a dose of epsom salts; I am called into corn fields to explain why the ears are not well filled—"Never happened before; always had good corn in this field." I am implored to wave a magic wand over a pickle field to correct nitrogen and potash starvation among the wry-necked specimens. Soybeans are drying up because of drought—no, they are hunting around for potash they cannot find. Spinach has something wrong with it—manganese has been reduced to a minimum. An apple crop of small, undersized, poor colored fruit, spindly tree growth, weak buds, is calling for attention.

These symptoms indicate a neglect, not intentional, but brought about through a repetition of practices that have not supplied adequate amounts of N, P_2O_5, or K_2O.

What Analysis and How Much?

I have asked several farmers in the country—"How do you know what analysis fertilizer to buy, and how much to use?" The answers form a variety of patterns.

First, there are those who say, with a gospel finality—"I buy what the fertilizer agent tells me to."

Second, there is the group which says: "Oh, I don't know, but I think I need a little more phosphorus and potash, so I buy a 5-10-10, and of course, manure."

Third, there is the class that figures out its need from Station recommendations, and acts accordingly.

Fourth, there is the group that buys the cheapest grade, regardless, and the least possible amount.

Fifth, believe it or not, there is an increasing number who bring soil samples to its county agent for rapid tests to discover the fertility level of various fields, with requests for recommendations to overcome deficiencies. The soil-testing services provided by the Station and commercial concerns are heavily patronized, particularly by those growing specialty crops, and the

idea is spreading among producers of other crops.

Soil samples sent to my office have tripled since 1938. The number of farmers submitting samples has nearly doubled. I do not think these farmers are using soil-testing services just for fun. I think that they realize that if properly used, they are an aid to better production of quality produce, and these men have sensed the need of literally looking into the soil for facts to guide them in a fertilizer program.

Hestor reveals that in 1941 a survey of 108 tomato growers showed those growing over 10 tons per acre had an average grade of 74% No. 1, and that those who produced less than 5 tons per acre had an average grade of 61% No. 1. (The latter presumably did not employ soil tests.) He concludes that soil testing "pays in quality." Again in 1944 he shows that in one county in Pennsylvania, tomato growers who tested their soil averaged 7.46 tons per acre, "whereas those without soil tests produced only 4.26 tons per acre."

Research and Practices

Do not get the idea that I believe mere soil testing itself results in increased yields. It is the facts that come to the surface, and the research that such exposures stimulate, that eventually produce results which can be translated into practices that really count—such as Hestor's determination to find out whether increased potash would produce high quality tomatoes. He concludes: "It has been observed that the fruit on plants getting a large amount of potash, mature dark red and carry a high amount of sugar and acid, which is a factor in quality."

Similar results have been noted in Delaware, where they had the hunch that potash might be the limiting factor in tomato production. Libby, McNeil & Libby, in cooperation with the Delaware Experiment Station and Extension Service, came to the conclusion that in 1940 "the use of 200 lbs. of muriate of potash per acre, above the regular fertilizer treatment, increased our quality from 12 to 16%." Average gain per 200 lbs. muriate per acre was 62 baskets, or over a ton per acre.

Wolf has associated the dollar returns per acre with the various amounts of different nutrients for asparagus. Over a two-year period, he asks us to "witness the 1942 returns of $225 per acre, where soluble P_2O_5 content of surface soil was over 30 lbs. per acre, as compared with $125 returns for those soils having less than 15 lbs. soluble P_2O_5 per acre.

"Also, the returns of $240 per acre when the soluble K_2O was between 300-400 lbs. per acre, as compared with $170 per acre for those fields containing 100-200 lbs. soluble K_2O per acre."

In my thinking, this reflects quality in the asparagus. It means better grades at the packing house. Wolf further found that asparagus growers who planted on rather infertile ground, poorly prepared soil, and who skimped on lime and fertilizer, consistently got low returns, and, I might add, undoubtedly low quality.

This low quality stuff is what we cannot put up with in New Jersey; it will not meet competition. If 2,000 lbs. of 5-10-10 on a soil well supplied with P_2O_5 and K_2O, as a result of previous good management, will produce the extra quality, there's a point for asparagus men to consider. My point is that the increased amount of fertilizer is demanded by the asparagus crop for quality production and that the increased amount is justified on the basis of demonstrated plant and soil needs.

My argument is that the successful use of fertilizers depends, in part, upon correctly tracking down the one or more deficiencies that are limiting production. That is what our New Jersey producers need to do, and there is a definite trend in that direction.

Stepping into the alfalfa field, we find that Bear, after a third degree applied to the agronomy specialists of the East designed to bring out some

(*Turn to page* 40)

Does it pay to mineralize? The right side of the picture had lime, phosphate, and potash. The left side had no minerals and no clover was the result.

Year-round Grazing

By W. R. Thompson

Agronomy Department, Mississippi State College, State College, Mississippi

ANY farmer in Mississippi who wants year-round grazing for his work stock, cattle, hogs, sheep, or poultry has it within his reach. He can find grazing crops that will grow each season. In fact, the pasture seasons are divided according to the time certain grazing crops will grow.

The secret of profitable pastures is a spread of grazing during the four seasons in place of a feast one season and a famine the next. One can visit the Mississippi Experiment Stations and demonstration farms and get a new hold on life as far as pastures are concerned. It's hard to believe what can be seen.

By planning for each pasture season, a Mississippi farmer can have winter grazing from November 1 to March 1; spring grazing from March 1 to June 1; summer grazing from June 1 to September 1; and fall grazing from September 1 to November 1. On the average, he will need about two acres of land in pasture for each animal unit on his farm. By an animal unit we mean a 1,000-pound cow, five sheep, five shoats, a sow and litter, three 300-pound calves, or 200 hens.

Winter Grazing

We usually think of the winter grazing season from November 1 to March 1 as the time when plants won't grow. But, many grazing crops will grow profitably in Mississippi during these months. R. H. Means of the Mississippi Experiment Station reports gains on beef calves all during the winter comparable to summer gains, with no supplemental feed. It is almost like a mi-

rage to see cattle standing knee-deep in oats during December and January and really fatter than summer grazing cattle.

Sheep can be kept on winter grazing every day. They are not heavy enough to bog. Demonstration flocks of sheep in Mississippi are being wintered on oats or oats and clovers with no extra feed. Sheep can graze oat fields where grain is to be harvested until March 1 without harming the oats. An acre of oats will give three to five sheep constant grazing.

Hogs on oats and legumes or Italian rye grass respond as any other animals on the farm to winter grazing. Farmers report about the only time hogs stop grazing is to take on grain. They eat far less grain than they would if they didn't have grazing. One farmer spent $230.25 on five acres of winter grazing for his hogs. Starting October 23 he charged 5¢ a day for each hog grazed. By January 1 he had liquidated the cost of minerals, preparation, and seed. He fed only half as much grain as he would have on dry-lot feeding. On January 1 he figured he had four more months of grazing and four years' supply of minerals—all profit.

In all sections of Mississippi an area in reach of hens in the laying house will give poultry winter grazing. The grazing is grown the same as for livestock. The method of grazing may change.

Farmers can give more land for each animal unit during the winter. Oats can be grazed and still grain yields will not be reduced if the correct minerals and nitrate are used.

Two areas of winter grazing land should be prepared in the summer, one on cultivated land to use for dry weather grazing, and the other area on sod land so it will not be too boggy to graze during wet and rainy weather. Part of the winter grazing on sod land gives a chance to renovate and get minerals into the soil. Payment for doing the job comes through oat grazing. Grain can be cut from the sod land the same as on cultivated land. The sod land will not be needed for grazing during oat-ripening period. Clovers are available at this time.

By planning, two and oftentimes three crops can be obtained from grazing crops planted. Oats on cultivated land will give three real crops in nine months—four months of winter grazing, a grain crop in June, and a hay or seed crop or more grazing from lespedeza interplanted in February. All of these crops will come off in time to plant oats back for winter grazing again.

Plant Food Needed

Most Mississippi soils need lime, phosphate, and potash for winter legumes and nitrate for oats. A soil test is the best way to know how much minerals to use. Not enough minerals will sometimes run the cost above the actual needs. The general recommendation for minerals is 2 to 3 tons lime; 250 pounds a year or a 4-year application at the 250-pound yearly rate of 20 per cent superphosphate; and 100 to 200 pounds of potash. Oats to be grazed should receive 30 pounds of nitrogen. Some farmers are using more nitrogen and making a profit.

Cultivated land to be used for grazing should be prepared well after applying minerals and nitrate to get them into the soil. Sod land should be disked thoroughly, but not as deep as cultivated land.

One hundred to 125 pounds of oats to the acre drilled do best. A system of drilling half of the seed one way and half in the other direction is being used. This gives better protection from erosion and a better grazing bed when wet. The last week in August and the first two weeks in September are the dates to plant oats for grazing. A cultipacker should be run over the planted seed. This packing often makes possible the grazing of oats during wet weather. The results of cultipacking are being watched by many farmers. It almost seems like backing up to tell

(*Turn to page* 46)

This is typical of what can be obtained from pasture limed and fertilized on the brown loam soils of Mississippi.

Above: **Temporary grazing from vetch and oats took care of this dairy herd during the winter and spring.**

Below: **Sheep do well on oats for winter grazing. Sheep in Mississippi can be pastured all during the year.**

Above: **This farmer had grazing for all livestock. Two acres of white clover were provided for brood sows and pigs.**

Below: **Oats and vetch carry cattle through the winter in slaughter condition. This picture was taken in February.**

Above: **Unimproved, unfertilized wire-grass pasture furnishes a small amount of grazing from hop clover in the spring.**

Below: **Fertilized with lime, phosphate, and potash and seeded to oats and crimson clover the same pasture as above carried a cow per acre all winter.**

The Editors Talk

How to Charge Off Fertilizer Costs

From time to time a question comes up as to how much of the cost of the fertilizer should be charged to the crop to which it is applied and how much of it might be assignable, from the residual effect, to later crops. This question not only is a factor in determining farm management practices and in figuring costs of production and profit but is important in settling terms of leases. The matter is becoming increasingly pertinent now that fertilizer applications universally are much higher than formerly and their cost can be a considerable item in determining both the cost of production of the crop and cost of capital investment in soil fertility. In European countries where farm tenancy is much more stable, rather exact procedures in allocating fertilizer costs have been worked out.

It is, therefore, gratifying to note in a recent press release from the Illinois College of Agriculture the ideas of J. B. Cunningham, farm management specialist, and A. L. Lang, chief in soil experiment fields, on how to charge off fertilizer costs. One plan should suffice for all purposes, these specialists concur, and the plan when once adopted should not be changed from year to year.

They recommend charging off the cost of a normal application of nitrogen, phosphate, and potash, applied either singly or in combination, in one year when used on field crops, and a heavier than average application in three years. For accounting purposes a normal application is:

1. Less than 100 pounds per acre of total plant food (nitrogen, phosphoric acid, and potash) in a mixed fertilizer, such as 2-12-6, 3-12-12, 8-8-8, and 0-20-20. For example, 300 pounds of 2-12-6 contain 60 pounds of plant food.

2. Less than 60 pounds per acre of plant food (phosphoric acid) in superphosphates, such as 0-20-0 and 0-45-0.

3. Less than 100 pounds per acre of plant food (potash) in potash-fertilizing materials, such as 0-0-50.

4. Any amount of nitrogen fertilizer.

A heavy application is more than the amounts listed.

Charging off the cost of limestone in five years and the cost of rock phosphate in ten years is suggested. This does not necessarily mean that all the benefits are obtained from the limestone in five years nor from the phosphate in ten. This plan has been used by most account keepers in Illinois for more than 25 years, with variations, of course, justified under certain conditions.

In these recommendations the specialists distinguish between outlays for plant-food materials which increase productivity over a period of years and those from which the benefit is of short duration. The former are considered capital investments to be charged off over a period of years. The latter are expenses to be charged off the year the fertilizers are applied.

Productive Pastures

Centuries of pasturing with no return of plant-food elements other than deposits of liquid and solid manure by grazing animals has resulted in a state of soil fertility that seriously threatens the livestock industry. The seriousness of the situation was first sensed in Europe by far-sighted scientists who took definite steps to effect a desirable change. Systems of pasture management which involved both rotational grazing and the replacement of minerals by application of commercial fertilizers were devised. Because of the relative newness of our country and the room for expansion, the efficient grazing of livestock did not become a problem here until, by comparison, recently. Fortunately American farmers are now being rapidly awakened to the need for pasture improvement through the efforts of research workers, extension people, and other agencies.

In this issue of the magazine are to be found two articles on pasture management—one, "Efficient Management for Abundant Pastures" by C. J. Chapman, of the Wisconsin College of Agriculture, and the other, "Year-round Grazing" by W. R. Thompson of Mississippi State College. Both show the progress which is being made in rebuilding soils for the support of livestock.

The fact that the above-mentioned articles happen to have come from the North and the South does not mean that the pasture problem is not national in scope. In recognition of how widespread was the need for arousing interest in better grasslands, a National Joint Committee on Grassland Farming was formed in 1944 under the sponsorship of the American Society of Agricultural Engineers, American Society of Animal Production, American Society of Agronomy, American Dairy Science Association, the National Fertilizer Association, National Association of Silo Manufacturers, Farm Equipment Institute, and the Soil Science Society of America.

The objectives of this Committee were determined as:

1. To promote cooperative research efforts among men in animal production, agricultural engineering, agronomy, chemistry, nutrition, and equipment manufacture, directed toward the solution of the problems of production, harvesting, processing, storage, and utilization of forage crops.
2. To promote correlation among experimental agencies, of research work completed, in progress, or contemplated.
3. To provide workers with information and ideas, to give opportunity for constructive criticism of methods and results, and to stimulate and arrange for necessary regional tests.
4. To assist in the development of equipment for producing, processing, handling, and storing of forage crops on various sized farms.
5. To act as a central clearing agency in the gathering of grassland data on materials, production, equipment, methods, and nutrition.
6. To release and disseminate clear information to the farm public on proven methods for the economic handling of all kinds of forage crops.

In connection with the latter, the Committee has published a well-illustrated, question-and-answer booklet entitled "Green Fields Are Gold." This may be obtained from member organizations or by writing to the Executive Secretary of the Committee, Box 30, Norwich, N. Y.

It is to be hoped that the Committee will "bear the fruit intended." When a problem becomes national in scope, we need a head or clearinghouse in which to center all information tending to its solution. The objectives of this Committee are particularly sound since they would bring together in cooperative effort the strivings not only of research men working in the interest of our soil maintenance, but of industries whose welfare depends upon the welfare of our agriculture.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1920	15.9	17.3	125.3	141.7	61.8	182.6	16.46	25.65	....
1921	17.0	19.5	113.3	113.1	52.3	103.0	11.63	29.14	....
1922	22.9	22.8	65.9	100.4	74.5	96.6	11.64	30.42	....
1923	28.7	19.0	92.5	120.6	82.5	92.6	13.08	41.23	....
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941	17.0	26.4	80.7	94.0	75.1	94.5	9.67	47.65	....
1942	19.0	36.9	117.0	119.0	91.7	109.8	10.80	45.61	....
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945	22.4	42.6	139.0	200.0	114.0	149.0	15.10	51.80	....
1946									
February	23.01	33.9	146.0	223.0	111.0	155.0	15.80	50.30	....
March	22.70	31.9	157.0	236.0	114.0	158.0	16.30	47.50	....
April	23.59	42.9	162.0	245.0	116.0	158.0	15.00	48.00	....
May	24.09	43.0	157.0	251.0	135.0	170.0	14.80	49.60	....
June	25.98	59.0	147.0	251.0	142.0	174.0	14.70	51.50	....
July	30.83	56.7	148.0	275.0	196.0	187.0	15.00	60.00	....
August	33.55	48.6	143.0	280.0	180.0	178.0	15.10	59.10	....
September	35.30	48.8	128.0	224.0	173.0	179.0	15.40	57.80	....
October	37.69	53.0	122.0	209.0	171.0	188.0	16.10	66.00	....
November	29.23	43.8	123.0	200.0	127.0	189.0	17.20	89.90	....
December	29.98	43.5	126.0	210.0	122.0	192.0	17.70	91.50	....
1947									
January	29.74	39.0	129.0	220.0	121.0	191.0	17.50	90.40	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1920	128	173	180	161	96	207	139	114	....
1921	137	195	163	129	81	117	98	129	....
1922	185	228	95	114	116	109	98	135	....
1923	231	190	133	137	129	105	110	183	....
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	420	214	219	170	160	138	234	212
1945	181	435	199	228	178	169	127	230	224
1946									
February	186	339	209	254	173	175	133	223	275
March	183	319	225	269	178	179	137	211	283
April	190	429	232	279	181	179	126	213	282
May	194	430	225	286	210	192	125	220	177
June	210	590	211	286	221	197	124	228	185
July	249	567	212	313	305	212	126	266	163
August	287	486	205	319	280	201	127	262	162
September	285	488	184	255	269	202	130	256	154
October	304	530	175	238	266	213	136	293	151
November	236	438	176	228	198	214	145	399	207
December	242	435	181	239	190	217	149	406	166
1947									
January	240	390	185	251	188	216	147	401	238

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.59	5.16
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946						
February	1.75	1.42	7.81	5.77	4.86	6.71
March	1.75	1.42	7.81	5.77	4.86	6.71
April	1.75	1.42	7.81	5.77	4.86	6.71
May	1.75	1.42	9.08	6.10	4.86	7.30
June	1.88	1.42	10.34	6.42	4.86	7.90
July	1.88	1.42	11.62	8.15	5.34	9.60
August	2.22	1.46	16.88	8.14	6.07	12.14
September	2.22	1.46	10.32	6.95	6.07	12.14
October	2.22	1.46	13.20	7.12	8.30	12.14
November	2.22	1.46	15.19	11.26	12.14	12.75
December	2.22	1.46	14.63	11.37	12.14	11.17
1947						
January	2.36	1.46	12.98	11.06	12.14	10.32
	Index Numbers (1910-14 = 100)					
1922	113	90	173	132	140	142
1923	112	102	177	137	136	147
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946						
February	65	50	223	163	144	191
March	65	50	223	163	144	191
April	65	50	223	163	144	191
May	65	50	259	173	144	207
June	70	50	295	182	144	224
July	70	50	332	231	158	273
August	83	51	482	231	180	345
September	83	51	295	197	180	345
October	83	51	377	202	246	345
November	83	51	434	319	360	362
December	83	51	418	322	360	317
1947						
January	88	51	371	313	360	293

Wholesale Prices of Phosphates and Potash **

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1922	.566	3.12	6.90	.632	.904	23.87	....
1923	.550	3.08	7.50	.588	.836	23.32	....
1924	.502	2.31	6.60	.582	.860	23.72	....
1925	.600	2.44	6.16	.584	.860	23.72	....
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.570
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946							
February	.650	2.20	6.40	.535	.797	26.00	.200
March	.650	2.20	6.40	.535	.797	26.00	.200
April	.650	2.20	6.40	.535	.797	26.00	.200
May	.650	2.20	6.40	.535	.797	26.00	.200
June	.650	2.30	6.45	.471	.729	22.88	.176
July	.650	2.60	6.60	.471	.729	22.88	.176
August	.700	2.60	6.60	.471	.729	22.88	.176
September	.700	2.60	6.60	.471	.729	22.88	.176
October	.700	2.60	6.60	.471	.729	22.88	.176
November	.700	2.60	6.60	.535	.797	26.00	.200
December	.700	2.60	6.60	.535	.797	26.00	.200
1947							
January	.700	2.60	6.60	.535	.797	26.00	.200
Index Numbers (1910-14 = 100)							
1922	106	87	141	89	95	99	....
1923	103	85	154	82	88	96	....
1924	94	64	135	82	90	98	....
1925	110	68	126	82	90	98	....
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946							
February	121	61	131	75	84	108	83
March	121	61	131	75	84	108	83
April	121	61	131	75	84	108	83
May	121	61	131	75	84	108	83
June	121	64	132	66	76	95	80
July	121	72	135	66	76	95	80
August	131	72	135	66	76	95	80
September	131	72	135	66	76	95	80
October	131	72	135	66	76	95	80
November	131	72	135	75	84	108	83
December	131	72	135	75	84	108	83
1947							
January	131	72	135	75	84	108	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1922	132	149	141	116	101	145	106	85
1923	143	152	147	114	107	144	103	79
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946								
February	207	185	156	97	57	175	121	78
March	209	187	158	97	57	175	121	78
April	212	188	160	97	57	175	121	78
May	211	192	162	99	57	189	121	76
June	218	196	163	100	60	203	121	70
July	244	209	181	103	60	230	121	70
August	249	214	187	116	67	293	131	70
September	243	210	181	108	67	223	131	70
October	273	218	197	115	67	286	131	70
November	263	224	198	127	67	382	131	78
December	264	225	204	127	67	376	131	78
1947								
January	260	227	233	126	69	359	131	78

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Since June 1941, manure salts are quoted F.O.B. mines exclusively.

**** The weighted average of prices actually paid for potash are lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Analyses and Registrations, 1946," Div. of Feed and Fertilizer Control, St. Paul, Minn.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 503, Dec. 1946.

"Analyses of Commercial Fertilizers, Manures, and Agricultural Lime, 1945," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Insp. Series 21, April 1946, Charles S. Cathcart.

"The Inspection of Commercial Fertilizers and Agricultural Lime Products for 1946," Rel. Service Div., Univ. of Vt., Burlington, Vt., Rept. 4, Nov. 1946, L. S. Walker and E. F. Boyce.

"The Use of Nitrogenous Fertilizers in the Production of Virginia Field Crops," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul. 397, May 1946, T. B. Hutcheson and M. H. McVickar.

"Report of Inspection Work: Commercial Fertilizers," Dept. of Agr., Charleston, W. Va., Bul. (n.s.) 49, July 31, 1945.

"The 1946-47 Fertilizer Program," Production and Marketing Admin., U.S.D.A., Washington, D. C., Jan. 1947.

Soils

"Physical Land Conditions in the Matanuska Valley, Alaska," Soil Cons. Serv., U.S.D.A., Washington, D. C., Phys. Land Survey No. 41, 1946, W. A. Rockie.

"Studies in Soil Structure: VI. Water Bound by Individual Soil Constituents as Influenced by Puddling," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 110, June 1946, T. F. Buehrer and D. G. Aldrich, Jr.

"Soil Survey of Cumberland County, Nova Scotia," Dominion Dept. of Agr., Truro, N. S., Canada, Rpt. No. 2, Oct. 1945, G. B. Whiteside, R. E. Wicklund, and G. R. Smith.

"La Reaccion del Suelo su Importancia Y Control," Editorial "Neptuno," S.A., La Habana, Cuba, Neptuno 559, Jose L. Amargos, M.A.

"Effects of Soil, Soil Treatment, Seasonal Variation, and Variety on Yield and Composition of Corn Crops Grown on Kentucky Soil Fertility Plots," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Bul. 485, May 1946, M. E. Weeks and E. N. Fergus.

"Report of the Chief of the Soil Conservation Service, 1946," U.S.D.A., Washington, D. C.

"Soil Survey—Kings County, California," U.S.D.A., Washington, D. C., Series 1938, No. 9, Oct. 1946, J. L. Retzer, R. A. Gardner, L. F. Koehler, and R. C. Cole.

"Soil Survey—Fulton County, Indiana," U.S.D.A., Washington, D. C., Series 1937, No. 17, Aug. 1946, O. C. Rogers, A. P. Bell, T. E. Barnes, Sutton Myers, and A. T. Wiancko.

"Soil Survey—Bucks County, Pennsylvania," U.S.D.A., Washington, D. C., Series 1936, No. 25, Oct. 1946, R. T. A. Burke, R. K. Craver, R. B. Alderfer, and E. C. Dunkle.

"Soil Survey—Hamblen County, Tennessee," U.S.D.A., Washington, D. C., Series 1940, No. 1, Oct. 1946, A. R. Aandahl, J. T. Miller, C. B. Beadles, M. E. Swann, and Foster Rudolph.

Crops

"Ninth Progress Report, 1942-1943," Agr. Exp. Sta., Univ. of Alaska, College, Alaska.

"Report of the Minister of Agriculture for the Dominion of Canada for the Year Ended March 31, 1946," Dept. of Agr., Ottawa, Canada, 1946.

"Seventy-First Annual Report of the Ontario Agricultural College and Experimental Farm, 1945," Dept. of Agr., Ontario, Canada, 1946.

"Frameworking Fruit Trees," Dominion Dept. of Agr., Ottawa, Canada, Publ. 781, F.B. 136, 1946, R. J. Hilton.

"Herbaceous Perennials for Canadian Gardens," Div. of Horticulture, Dept. of Agr., Ottawa, Canada, Publ. 784, F.B. 138, Dec. 1946, Isabella Preston.

"Annual Report of the Connecticut Agricultural Experiment Station for Year Ending October 31, 1945," Agr. Exp. Sta., New Haven, Conn., Publ. Document No. 24.

"Ornamental Trees," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Bul. 95, Rev. July 1946, Harold Mowry.

"Camellia Growing," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Bul. 130, Nov. 1946, R. J. Wilmot.

"The Florida Home Garden," Agr. Ext.

Serv., Univ. of Fla., Gainesville, Fla., Bul. 131, Dec. 1946, F. S. Jamison.

"Fifty-second Annual Report: Wartime Agricultural Research," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 264, July 1945.

"Fifty-seventh Annual Report, Year Ending June 30, 1944," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind.

"Growing an Orchard in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Bul. 330, Aug. 1946.

"Report of Progress for Year Ending June 30, 1945," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 438, June 1945.

"Small Grain Variety Trials, 1932-1945," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 445, July 1946.

"Recommendations for the 1947 Production of Tomatoes for Manufacture in New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Nov. 1, 1946.

"Nut-Growing," College of Agr., Cornell Univ., Ithaca, N. Y., Ext. Bul. 701, Sept. 1946, L. H. MacDaniels.

"1946 Rose Test at the Pennsylvania State College," Agr. Exp. Sta., Pa. State College, State College, Pa., Paper No. 1359, Jan. 17, 1947, E. I. Wilde and R. P. Meahl.

"Tobacco Plant Production in South Carolina," Clemson Agr. College, Clemson, S. C., Cir. 291, Sept. 1946, H. A. McGee, J. M. Lewis, and J. R. Mattison.

"Progress Report of Research in Crops and Soils," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Cir. 65, Aug. 1946, W. W. Worzella, A. N. Hume, L. F. Puhr, J. E. Grafius, E. L. Erickson, K. F. Manke, C. J. Franzke, and E. C. Joy.

"Annual Report, 1944," Ext. Serv., Texas A & M, College Station, Texas.

"Eggplant Production in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1038, Sept. 18, 1946, W. H. Friend.

"Irish Potato Production in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1040, Oct. 3, 1946, W. H. Friend.

"Snap Beans for Marketing and Processing," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1041, Oct. 3, 1946, W. H. Friend.

"Introducing Three New Berry Varieties of the Ness Family," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1043, Oct. 31, 1946, S. H. Yarnell.

"Strawberry Growing in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1044, Oct. 31, 1946, W. H. Friend.

"Fruits for Home Use and Local Markets," Agr. Exp. Sta., Texas A & M, College Station, Texas, P.R. 1045, Oct. 31, 1946, W. H. Friend.

"Report of the College of Agriculture, University of Vermont, July 1, 1945-June 30, 1946," College of Agr., Univ. of Vt., Burlington, Vt., A.R. No. 2, Dec. 1946.

"Vermont Agriculture, 1945-1946," Dept. of Agr., Montpelier, Vt., 23rd Biennial Rept.

"The Culture of Aromatic (Turkish) Tobacco," Va. Polytechnic Inst., Blacksburg, Va., Cir. 397, May 1946, H. W. Jackson.

"17th Biennial Report, July 1, 1944 to June 30, 1946," Dept. of Agr., Charleston, W. Va.

"Celery Growing in Wisconsin," Ext. Serv., College of Agr., Univ. of Wis., Madison, Wis., Stencil Cir. 159, Rev. Aug. 1946, James G. Moore.

"Report of the Chief of the Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, 1946," U.S.D.A., Washington, D. C.

"Report of the Chief of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, 1946," U.S.D.A., Washington, D. C.

"Studies on the Germination of Guayule Seed," U.S.D.A., Washington, D. C., Tech. Bul. 921, Oct. 1946, H. M. Benedict and Jeanette Robinson.

"Growth and Rubber Accumulation in Guayule as Conditioned by Soil Salinity and Irrigation Regime," U.S.D.A., Washington, D. C., Tech. Bul. 925, Nov. 1946, C. H. Wadleigh, H. G. Gauch, and O. C. Magistad.

Economics

"Cattle Ranching in Western Canada," Dept. of Agr., Ottawa, Canada, Publ. 778, Feb. 1946, C. W. Vrooman, G. D. Chattaway, and Andrew Stewart.

"Connecticut Vegetable Acreages, 1944-1945-1946," Dept. of Agr., Hartford, Conn., Bul. 95, Dec. 1946.

"Suggested Agricultural Production for Delaware, 1947," Agr. Exp. Sta., Univ. of Del., Newark, Del., Pamph. 26, Aug. 1946, R. O. Bausman.

"Handbook for Local 4-H Club Leaders," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Cir. 81, Oct. 1946, R. W. Blacklock and W. W. Bassett, Jr.

"Recent Changes in Production Methods on Maine Potato Farms," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 444, July 1946.

"Farm Costs Are Mounting," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 147, Dec. 1946, J. B. McNulty.

"Agricultural Outlook," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Pamph. 150, Jan. 1947, W. H. Dankers.

"Organizing Dairy Farms for Efficient Production," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 478, April 1946.

"Types of Farming in Pennsylvania," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 479, May 1946.

"New Americans in Rural Rhode Island," Agr. Exp. Sta., Kingston, R. I., Bul. 298, June 1946, W. R. Gordon and A. A. Asadorian.

"Virginia Farm Real Estate Trends in Seven Counties During 1941-1945," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., Bul.

400, July 1946, H. M. Love and W. H. Scofield.

"The 1947 Agricultural Conservation Program Handbook for: SRB-1101-Ala.; SRB-1101-Ark.; SRB-1101-Fla.; SRB-1101-Ga.; SRB-1101-La.; SRB-1101-Miss.; SRB-1101-Okla.; SRB-1101-S.C.; SRB-1101-Tex., U.S.D.A., Washington, D. C.

"The 1947 Agricultural Conservation Program for: NER-1110-Conn.; NER-1110-Maine; NER-1110-N. Y., U.S.D.A., Washington, D. C.

"Kentucky Handbook of Conservation Practices, 1947," ECR-1101-Ky., U.S.D.A., Washington, D. C., Sept. 30, 1946.

"The Agricultural Conservation Program for Oregon, 1947 Handbook," WR-47-1, Oregon, U.S.D.A., Washington, D. C.

Radioactive Research

USING radioactive iodine supplied by "Manhattan District," Oak Ridge, Tenn., three U. S. Department of Agriculture scientists report experiments with a synthetic radioactive chemical that gives new light on 2,4-D as a weedkiller. These tests are explorations in working out answers to some of the many "what?" "how?" "where?" and "why?" questions that puzzle science in connection with 2,4-D and other growth-regulating substances. This new research tool is identified by the initials, "INBA"—the first standing for the iodine.

Applied to a leaf of a young bean plant the INBA moves through the plant and concentrates in partly expanded leaves at the growing point and severely checks their growth. Applied similarly to a barley plant, INBA likewise concentrates in the young leaves but apparently does not injure the plant much. The radioactivity makes it possible to use a delicate instrument—an electrometer—to trace the INBA moving in the plant in a manner similar to that used to trace iodine and other elements in animals.

In some respects INBA acts similarly to 2,4-D, which has developed in a few years from a laboratory novelty to have enormous practical value, particularly as a weedkiller. Like 2,4-D, the INBA has a selective effect, injuring the broad leaf beans but having only slight effect on the grassy barley.

In applying this by-product of atomic bomb research to plant study, the investigators are looking forward to the possible use of INBA and other closely related growth regulators in practical crop production. Fortunately INBA is fairly easy to synthesize in the laboratory, and radioactive iodine can readily be obtained. Radioactive iodine has a "half life" (loses half its radiant power) of 8 days, which is longer than many radioactive chemicals.

But quick work and use with young and rapidly developing plants are necessary to make effective use of the radiation in following out the results of INBA treatments.

The immediate object is to gain new information leading to a better understanding of this relatively new field of plant research on "growth-regulating substances." Broadly it should help in explaining and suggesting new studies of the physical, chemical, and biological results that are brought about by the action of vitamins, enzymes, hormones, viruses, genes, and microscopic quantities of some minerals.

Farm System Decides Fertilizer Needs

"HOW much fertilizer should I use in grain and livestock systems of farming?" is a common question being asked agronomists at Purdue University this winter.

G. P. Walker, extension agronomist,

bases his answer on results obtained from the long-time operation of these two systems on two Purdue experimental fields. In the livestock system on the Soils and Crops Farm located near Lafayette, 300 pounds of 2-12-12 fertilizer on wheat and 100 pounds of 0-12-12 in the hill for corn in combination with eight tons of manure have produced an average of 78 bushels of corn and 40 bushels of wheat per acre during the past six years, in a rotation of corn, wheat, and clover. The same amounts of 2-12-20 fertilizer with manure have produced yields averaging 90 bushels of corn and 30 bushels of wheat per acre in the same rotation on the gray silt loam soil of the Jennings County Experiment Farm near North Vernon.

In the livestock system of farming, all the phosphate and about 55 to 60 per cent of all the potash removed in the harvested crops have been returned to the soil. The profits over costs, during this period, have been larger from these treatments than from any which restored less phosphate and potash to the soil.

In a straight grain system of farming, corn, soybeans, and wheat (with sweet clover intercrop), the agronomist points out that on the Lafayette farm, yields averaging 76 bushels of corn, 30 bushels of soybeans, and 36 bushels of wheat per acre were produced during the same period. The fertilizer used was 300 pounds of 3-12-12 on wheat, 100 of 0-12-12 in the corn hill, 60 pounds of potash plowed under for corn, and 20 pounds of nitrogen broadcast on wheat in April. Under this system of fertilization, the equivalent of all the phosphate and potash removed in the harvested grains was also returned to the soil and likewise produced larger returns over costs than were obtained from comparative studies where lesser amounts of fertilizer were applied.

Increased Quality of Products Is Answer to the Problem

(*From page* 24)

facts concerning the whimsies of alfalfa, "gathered from their replies that the important thing was to keep the crop so well fed that it could ward off disease, and hold its own in competition with other grasses." Then he goes on to show that even "if alfalfa got half its food from soil reserves, you still would have to use a ton each of superphosphate and potash to sustain a 4-ton alfalfa crop over a 10-year period."

Ten pounds of borax increased a spinach yield by 6,534 lbs. in Passaic County. The grower's income was increased $230 per acre by a small investment of time and money.

Sixty pounds of manganese sulphate per acre produced a marked difference in quality when applied to a Camden County spinach patch last September. The manganese deficiency was discovered by a soil test and was verified by a plant-tissue test.

You have noted that many of the instances I have cited call for the use of fertilizer materials in excess of the usual recommendations. This may be comforting to fertilizer salesmen looking for increased commissions. It may be disturbing to producers who feel their fertilizer bill is high enough as it is. But researchers have apparently uncovered enough facts which point to the necessity of feeding crops what they really need, in order to produce quality goods. Producers might well consider that increased returns stand ready for those who are awake to the significance of Scarseth's statement that in 1945 "if all the phosphate used in the nation went only to corn land, the corn would be fairly well fertilized," and that "re-

turning to the soil just the phosphate the grain takes off would be supplying only half as much as is agronomically and economically sound." . . . "In 1946," he says, "we are returning to the land only about 2 to 5% of the potash lost by crop removal and erosion."

"Hunger Signs in Crops," to borrow a title of a very good book, might well have been the heading for this discourse.

Should we overlook these signs? This sign language of the plants tells an exceedingly significant story. I think that we as agricultural agents could well spend much more time in the detailed study of these hunger symptoms, their cause, identification, and remedy, so that we can more specifically point out to growers the cause and treatment for these troubles which they find interfering with quality production.

A wealth of research has been done on these matters. Experiment Station workers, the American Society of Agronomy, the National Fertilizer Association, processing companies, and the U. S. Department of Agriculture have brought together a vast store of information of a real practical nature, which is simply crying for dissemination among a clientele which I believe is ready to receive it.

This information is not for the sole edification of the scientists who produced it. It has dollar and cents value to growers, to fertilizer men, and eventually to society at large, which, whether it knows it or not, has its very existence bound up in the profitable production of healthy plants.

Bibliography

Hoffer, G. N. *Potash Fertilizers Are Needed on Many Midwestern Farms.* Better Crops With Plant Food. Vol. 29, No. 7 (Aug.-Sept. 1945).

Hester, J. B. *Soil Testing—A Practical Aid to the Grower and Industry.* Better Crops With Plant Food. Vol. 30, No. 8 (Oct. 1946).

Wolf, Benjamin. *Soil Fertility's Effect on Dollar Returns from Asparagus.* Better Crops With Plant Food. Vol. 28, No. 7 (Aug.-Sept. 1944).

Stephenson, R. E. *Fertilizing for Yield and Soil Improvement.* Better Crops With Plant Food. Vol. 28, No. 8 (Oct. 1944).

Cobb, G. R. *Potash Increases Tomato Yield and Quality.* Better Crops With Plant Food. Vol. 30, No. 1 (Jan. 1946).

Bear, F. E. *Feed for Dairy Farms.* New Jersey Crop Improvement Association.

New Jersey Agricultural Experiment Station, Soils Department. *Summary of Research Activities.* (April, 1943).

Nissley, C. H. *Applying Fertilizer to Vegetables in Irrigation Water.* Horticultural News. (Nov. 1946).

Scarseth, G. D. *Bumper Grain Crop Robs U. S. Soil of Needed Plant Food.* American Farm Bureau Federation. Official Letter (Nov. 13, 1946).

New Jersey Agricultural Experiment Station. *Fertilizers for New Jersey.* Circular 475, (Jan. 1944).

New Jersey Agricultural Experiment Station. *Answers to Your Tomato Problem.* Circular 414 (May 1941).

Sugar Beets Require Adequate Soil Aeration

(*From page* 10)

to why it is so essential for adequate aeration during the production of sugar beets following the growth of a leguminous crop.

Summary

The results obtained in this greenhouse experiment suggest that adequate aeration of the soil is very necessary for the production of sugar beets. Compaction alone of the soil, as used in this experiment, was much more detrimental than an application of excess water alone; but used in combination, the effects were even much more pronounced. Compaction of the soil alone and in combination with excess water resulted in marked disturbance of the

TABLE 3. YIELD OF SUGAR BEET TOPS.

Physical treatment	Mean[1] dry weight of sugar beet tops for			Series average grams
	Alfalfa series grams	Corn series grams	Sweet clover series grams	
1. Normal	27.6	20.6	30.3	26.2
2. Aeration	27.9	16.7	32.6	25.7
3. Compaction	3.4	9.2	2.7	5.1
4. Aeration and compaction	12.7	11.8	6.3	10.3
5. Excess water	31.4	24.2	29.2	28.3
6. Excess water and aeration	33.9	16.1	33.7	27.9
7. Excess water and compaction	.5	.6	1.3	.8
8. Excess water, aeration, and compaction	4.6	4.5	6.0	5.0
Average for all treatments	17.7	13.0	17.8	16.2

[1] Mean of four replicates.

normal oxidation and nitrification processes which occur in the soil. Inadequate aeration apparently was more injurious to sugar beets following legumes than to beets following corn.

Literature Cited

1. Farnsworth, R. B. *The effects of soil structure on sugar beets.* Abstracts of Doctoral Dissertations, No. 35. The Ohio State University Press. 1941.

2. Hoffer, G. N. *Fertilized corn plants require well-ventilated soils.* Better Crops With Plant Food 29:(1). 1945.

3. Hoffer, G. N. *Some whys and wherefores for air-conditioning soils.* Better Crops With Plant Food 29:(2). 1945.

4. Lawton, K. *Soil aeration affects fertilizer needs.* Better Crops With Plant Food 30:(8). 1946.

5. Prince, A. L. *Determination of total nitrogen, ammonia, nitrates, and nitrites in soils.* Soil. Sci. 59:47-52. 1945.

6. Smith, F. W. *The effect of soil aeration, moisture, and compaction on nitrification and oxidation and the growth of sugar beets following corn and legumes in pot cultures.* Master's Thesis. Michigan State College. 1946.

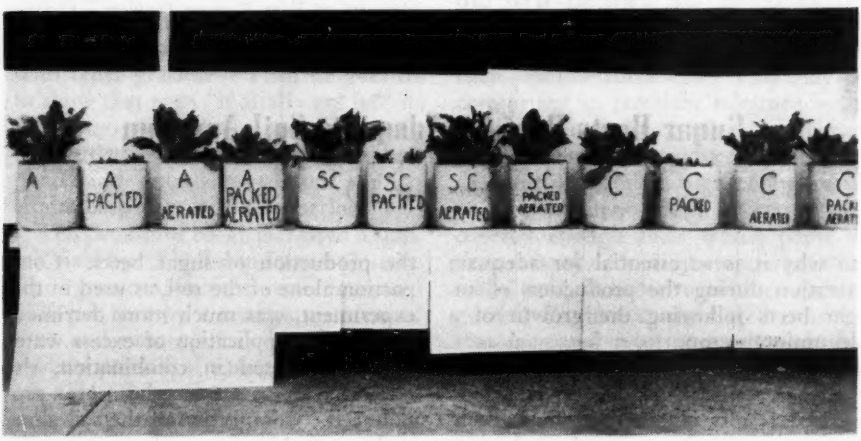

Fig. 6. The relative growth of sugar beets in the various cultures of the series is presented for comparison. Note the striking similarity of growth regardless of previous crop.

Efficient Management for Abundant Pastures

(*From page* 22)

the soil and becomes available with late summer and fall rains, or may even be carried over to the following spring.

Lime-Phosphate-Potash Supply Must Be Maintained

It is true the increased growth of grasses due to nitrogen fertilization will quickly use up the supplies of readily available phosphate, potash, and lime in our soils, and it soon becomes necessary to use mineral fertilizers on our pastures. In fact, we recommend the liming of acid pasture lands at the outset. A basic treatment of phosphate and potash is also recommended for most pasture lands along with the nitrogen fertilizer. The application of from 300 to 500 pounds per acre of such mixtures as 0-20-10 or 0-20-20 every four years is suggested. On the more fertile pasture lands nitrogen fertilizers alone may be used for a period of two or three years before it becomes necessary to replenish the phosphate-potash reserves of these soils.

Nitrogen fertilizers are grass fertilizers and should not be used on pastures where clover or other legumes predominate. Legumes fix most of their own nitrogen.

Profits Shown in Demonstrations

Numerous trials and demonstrations have been conducted to determine the actual returns which can be expected from the use of nitrogen fertilizers on permanent grassland pastures. In most of the demonstrations carried out by the writer, the response to treatment with nitrogen fertilizers was measured in terms of milk production. In these demonstrations uniform pasture fields were divided in equal halves. One half of each was treated with a nitrogen fertilizer. Records were kept of the number of days the cows grazed on each half and also the pounds of milk produced.

In the spring of 1945 a demonstration was set up on the Wells Himsel farm at Paoli (Dane County, Wisconsin). A 23-acre creek bottom pasture was selected. It was divided in half with an electric fence. Ammonium nitrate (33% nitrogen) was applied at the rate of 200 pounds per acre on the west half of this pasture. The entire herd of 20 dairy cattle was turned into the fertilized half on May 19. They were rotated back and forth from the fertilized to unfertilized portions for a period of 4 months and 26 days. The experiment was terminated October 10.

The fertilized half was ready for grazing a good week earlier than the unfertilized and for the period from May 19 to the middle of July there was a tremendous difference in the amount of grass on the fertilized as compared to the unfertilized half. One notable observation made during the July-August period was the great difference in weed infestation. The unfertilized portion became badly infested with white top daisy and other weeds. There were very few weeds in the fertilized half due apparently to the early vigorous and rank growth of the grass. This lush growth of grass, as well as the weeds in this early stage, was grazed off. There was a noticeable difference during the entire summer in the thickness of the turf—the fertilized half produced a matted sod where the unfertilized half was always thin and sparse.

Except for a period of 14 days (September 4 to 18) this 23-acre pasture furnished all of the feed for the whole herd the entire summer. (During the period September 4 to 18 the herd had access to a stubble field of new seeding clover as a supplement to the feed furnished from the fertilized half. One-half of the milk production was credited to the extra feed furnished from the field of new seeding clover.) The results are shown in Table 1.

TABLE 1. RESULTS OF FERTILIZED-PASTURE DEMONSTRATION ON WELLS HIMSEL FARM.

Number of pasture days for entire herd on fertilized area	96
Number of pasture days for entire herd on unfertilized area	50
Pounds of milk produced while on fertilized half	31,479
Pounds of milk credited to new seeding clover (14 days) (½ of total production for period September 4–18)	1,580
Total net pounds of milk credited to fertilized pasture	29,899
Total pounds of milk produced while on unfertilized pasture	16,678
Pounds of milk increase resulting from fertilizer	13,221
Value of 13,221 pounds of milk at $3.25 per cwt.	$429.68
Value of pasture for 3 heifers, 3 dry cows, and 1 bull (46 days)	$ 15.00
Total value of increased production due to fertilizer	$444.68
Cost of ammonium nitrate used on fertilized half	$ 48.00

This and many other demonstrations have proven without question that nitrogen fertilizer can be used profitably on much of our better permanent pastures in Wisconsin. A handsome profit has been shown in this demonstration. The increase in milk production was due not only to the larger amount of grass but also to an improvement in the quality as well. Analyses for the protein content of the grass from each area were made in the early stage of growth (May 20th). Oven-dried samples from the fertilized portion yielded 23.1% protein as compared to 17.5% for the unfertilized grass. Mr. Himsel's cattle grazed the tender, lush, fertilized grass with apparent eagerness and relish.

But again I wish to point out that the available supply of essential minerals (lime, phosphate, and potash) must be maintained at reasonable levels in our pastures in order that the nitrogen fertilizers may produce maximum increases. Adequate supplies of these minerals are essential in the synthesis and building of the organic constituents of the forage produced on these pastures. In turn, lime and phosphorus are important in the animal body-building and maintenance functions and are needed in abundance by dairy cattle in the production of milk. Potash is said by some authorities to play an important role in connection with the synthesis of vitamin A. Where these mineral elements are lacking in a soil the forage will be deficient in them and in turn these deficiencies will be reflected in the health of our livestock. And so it is important to lime acid pasture land and apply phosphate and potash fertilizers where soil tests indicate a need for these minerals.

Summary

1. The renovation of old established grass pastures is the number one practice recommended in a long-time pasture improvement program. The rejuvenation of these old pastures can be accomplished by the liberal application of lime and mineral fertilizers, thorough seedbed preparation, and the seeding and establishment of deep-rooted legumes and grasses.

2. The application of nitrogen fertilizer should be confined to those pastures where the moisture-holding capacity is good and where there is a fair to good turf to start with. The fertilization of thin, poor turf on droughty or grub-infested pastures is not recommended.

3. Grass pastures will be ready for grazing from five to seven days earlier in the spring providing the fertilizer is applied a good two weeks before growth starts. Best results will be ob-

tained where the fertilizer is applied early. However, fair responses have been observed even where applied up to the middle of May.

4. The production of a thick-matted turf of rank-growing grasses will choke and subdue to a considerable extent the growth of weeds such as orange hawkweed, daisies, ragweed, and yarrow. (This is especially true where the early growth of grasses is grazed off uniformly during the early months of May and June.) The early grazing of the lush growth of grass is desirable also in order that the native white clover and other legumes be given opportunity for establishment and growth.

5. The continuous use of straight nitrogen fertilizer will eventually deplete the reserves of minerals in the soil (lime, phosphorus, and potash). The liming of acid pastures is recommended. Treatment with phosphate-potash fertilizers is likewise suggested on fields where soil tests show inadequate supplies of these elements.

6. Old renovated pastures, where the legumes (clovers and alfalfa) have disappeared, will respond generously to treatment with nitrogen fertilizer.

7. The application of nitrogen fertilizer in the early fall is not recommended in Wisconsin. Late fall application of nitrogen fertilizers (after growth has ceased and just before or after freeze-up) is permissible.

8. Nitrogen fertilizers are not recommended for pastures where clover or other legumes predominate. Legumes fix their own nitrogen.

Pasture improvement through the use of nitrogen and mineral fertilizers now looms up on the horizon of postwar opportunities. We must again begin to think of low unit cost production. I am convinced that there are millions of acres of pasture lands in Wisconsin and other Midwestern states where the application of nitrogen will be found highly profitable. We now have in this country a great new potential source of a protein feed in these synthetic ammonia plants which were built during the war period. This increased capacity for the production of fixed

This Jersey cow is suffering from a phosphorus deficiency disease known as "Pica." The soils in certain areas of northeastern Wisconsin, where this picture was taken, are known to be extremely deficient in available phosphorus. Liberal treatment with mineral fertilizers, such as 0-20-10 or 0-20-20, is recommended in addition to treatment with nitrogen on such soils.

nitrogen added to our normal output of ammonia sulphate and other nitrogen fertilizers plus imports of sodium nitrate should and will provide farmers with low-cost nitrogen fertilizers in the years ahead. More abundant pastures will give us low cost feed and in turn will make possible greater production of low cost milk, meat, and other food products.

Recent South Carolina Studies on Potash with Cotton

(*From page* 17)

of sodium may materially increase the yield of cotton where there is a relatively light application of potash and that certain combinations of potassium and sodium are as effective as equivalent quantities of potassium. For example, 30 pounds of potash in combination with sodium gave practically as high production as the 40 pounds of potash alone. The 25-pound application of potash plus a side-dressing of nitrate of soda produced a higher yield than the 30 pounds of potash without sodium nitrate as a side-dressing."

In the 600 pounds per acre of 5-10-0 plus sodium chloride and potassium chloride applied in these tests, the 15 pounds of nitrogen applied as a side-dressing was one-half from cottonseed meal and one-half from ammonium sulphate. Equal poundage of the two chlorides was used.

The plots receiving the equivalent of 40 pounds of sodium oxide (Na_2O) from sodium chloride yielded 46 per cent more seed cotton than the plots which did not receive sodium chloride or potassium chloride. The plots which received the equivalent of 25 pounds of Na_2O and 15 pounds of K_2O and the plots which received the equivalent of 10 pounds of Na_2O and 30 pounds of K_2O yielded 98 and 174 per cent more respectively, than the plots which received neither Na_2O or K_2O. The 40 pounds of K_2O alone resulted in a 160 per cent increase.

In his studies of the function of plant nutrients, Dr. Cooper has found experimental data to indicate definitely "that certain mineral nutrients can partly replace or supplement each other in the nutrition of plants." On this point he says:

"After supplying the quantity of a nutrient such as potassium necessary for its specific function, it is possible that another similar chemical element such as sodium or rubidium may be utilized by certain plants in maintaining a favorable ionic balance in the plant and that it will produce approximately the same growth response as an equivalent amount of additional potassium. Therefore, where both potassium and sodium are added in fertilizers, it is necessary to consider the possible growth response from the sodium after the specific requirement of the plants for potassium is met."

Year-round Grazing

(*From page* 26)

a farmer to do a good job of tearing land up and do a better job packing it down again, however the benefits of the cultipacker cannot be overemphasized.

Oats are planted in two ways for winter grazing. By one system, oats are planted alone to be followed by lespedeza in February or March. The oats are cut for grain and the lespedeza

grazed or cut for hay or seed. With the other system, oats and legumes are grazed off, cut for hay or seed, and followed by Sweet Sudan or grain sorghum or Alyce clover.

Legumes to plant with oats include crimson clover, vetch, wild winter peas, and red clover. Seed crimson clover at the rate of 20 pounds to the acre and cultipack after oats are drilled. Seed 25 pounds of vetch or 40 pounds of wild winter peas to the acre at the time the oats are planted. Cultipack 10 pounds of red clover to each acre after oats are planted.

During mild winters legumes give plenty of grazing, but they grow best in the early spring. Mississippi's best early winter grazing crop is oats. Oats and legumes can be grazed off, cut for hay while oats are in dough stage, or left and legume seed and oats harvested. After legume and oat crops, summer grazing crops can be planted.

The grazing of oats can be started about October 15 or November 1 when they are six inches high. They can be grazed through the winter by turning livestock on the sod land when the ground is wet. Stop grazing oats on March 1 and move the livestock to clovers or legumes. Top-dress oats with 30 pounds of nitrogen for grain.

Interplant oats alone with 25 pounds of lespedeza the last of February or the first of March and top-dress with 30 pounds of nitrogen. Grain production will not be cut by grazing during winter. In south Mississippi, Alyce clover gives grazing during early winter and at the same time volunteer winter peas are coming up in the clover for later grazing. The black belt and delta areas use winter peas for winter grazing where farmers let seed volunteer, especially in Johnson grass fields.

Many cotton and livestock farmers are planting a legume and oats in cotton with the last cultivation. They plant 75 pounds of oats with either 40 pounds of winter peas or 25 pounds of vetch.

Spring Grazing

Spring grazing is clover and legume grazing mostly. The season runs from March 1 to June 1. Farmers should allow a third of an acre for each cow for spring grazing.

The work toward spring grazing is done in the fall. The land is prepared, mineralized, and seeded. Land should be prepared well for clovers. Either cultipack it or let rain settle it before planting. Inoculate clover seed and plant in October on top of the prepared seedbed. Plant clovers with wheelbarrow seeder or cyclone seeder.

Clovers are heavy users of the minerals—lime, phosphate, and potash. A soil test is the best way to determine the minerals needed. Generally clovers need 500 pounds of 20 per cent superphosphate, 100 to 200 pounds of potash, 2 to 3 tons lime, or 1,000 pounds of basic slag in place of the lime and phosphate.

For all sections of Mississippi white Dutch clover is best. It makes the best growth when it is planted and grown alone. To keep a balance of grasses and legumes, it is best to plant white Dutch with dallis grass or in special areas with Italian rye or fescue grass. Grasses help in bloat control.

If one-fourth of the land to be planted in white Dutch can be mineralized and renovated each year, a balance between clover and grasses can be kept and a 4-year supply of minerals on the section renovated can be applied. Bermuda and carpet grasses tend to take charge of clover fields in Mississippi in 4 to 5 years.

Dallis grass can be planted on the white Dutch area in October at the same time clovers are being planted. Drill 15 pounds of good seed before running cultipacker for white Dutch planting. A successful way to get a stand of dallis is to mulch dallis grass hay at the rate of 1 ton to 3 acres. By protecting white Dutch clover the first season, the dallis grass can become established.

Winter grazing of clovers should be

confined to established clovers and not to newly planted clover. Established clover will give oat fields relief during the winter. Graze them a few days at a time or fit them into rainy weather grazing. Start grazing a new clover area when it is 4 inches high.

White Dutch clover is planted 5 pounds to the acre, hop clover 3 to 5 pounds, crimson clover 20 pounds, subterranean clover 3 to 5 pounds, red clover 8 to 10 pounds, and black medic 5 pounds. Other legumes used for winter and spring grazing are wild winter peas and vetch. Winter peas and vetch can be grazed on cropland and later used as cover crops or used for grazing and harvested for seed.

As a general rule, Mississippi has plenty of grazing during the spring season. If farmers don't prepare for good summer grazing, they will lose clover gains on scant summer pastures. Twice during the clover-grazing period, run a spike-tooth harrow over the area to scatter the manure. If this is not done, cows will graze one area closely and let the other grow. They leave the plants because of an overbalanced condition in the plant, especially of nitrogen products.

Sometimes it pays to mow clover to keep it from maturing. Clovers do not grow after blooming out. The plants will keep growing when the old growth is mowed off. Most livestock like growing plants better than mature plants.

When cattle are moved from clovers to summer pasture, drag the harrow again and mow the area to remove any mature clover or weeds. This clover area will be ready for grazing again in 3 or 4 weeks as a summer dallis pasture. The nitrate stored by the pasture is ideal for dallis grass production.

Summer Pastures

An acre should be allowed for each animal unit during the summer pasture season from June 1 to September. The history of pastures is that the summer pasture should be the best. Farmers today are recognizing that they need to plan and care for their summer pastures more than any other. The two worst enemies of summer pastures are lack of moisture and weed growth.

The permanent pasture for summer is dallis following clovers and dallis and Bermuda with lespedeza. If this area is allowed to get a start while livestock are on spring clovers, there will be good grazing waiting when clover grazing is over.

The sod pasture which is used for planting oats for grazing will be in excellent condition for summer pasture. Lespedeza interplanted in oats furnishes ideal summer grazing.

Thirty pounds to the acre of Sweet Sudan can be planted following winter peas or oats and legumes. Nitrate at the rate of 30 pounds of nitrogen to the acre pays off on Sudan. Sudan can be grazed when it is 12 to 18 inches high. Control the grazing for best results. It is easy to graze dairy cattle two hours a day and then turn them back to permanent pasture.

Alyce clover furnishes more grazing for south Mississippi than most any other plant and fits into the spring legume and grain crop rotation. The biggest enemies of Alyce clover are grass and weeds choking it out before the plants get established. Alyce clover is planted 30 pounds to the acre.

Kudzu furnishes good grazing during August and September and helps out in conserving soil in sections where it grows well.

Weeds and grass must be controlled. One way is to plant on new land or land which had a heavy spring legume crop. The other is to graze or mow the first crop of weeds and grass. The mowing machine is one of the best tools for pasture improvement. Regular mowing controls weeds and keeps grasses and clovers balanced.

Johnson grass in the delta and black belt areas furnishes good grazing, where established. If winter peas grew in the Johnson grass during the winter and spring, they added the necessary nitrogen. Johnson grass will

Dallis grass and white Dutch clover grow well together—the dallis for summer grazing, the white Dutch for spring.

not be profitable if it is not cultivated in some way.

If summer pastures can be given a rest during the last of the summer, they will give profitable grazing in the fall. If they are grazed closely all summer, little fall grazing from summer pastures can be obtained.

Fall Pastures

Fall pastures will be good if the summer pastures are treated and managed properly. The fall pasture season runs from September 1 to November 1.

Dallis and Bermuda grass put out new growth with the first rain in the fall. Mow pasture in September to get rid of weeds and mature grass. Clipping encourages new growth. Grain sorghum fields furnish some supplemental grazing in the fall. Corn and bean fields, after the corn is harvested, will also supplement pastures.

Fall is the ideal time to apply minerals on established stands of grasses and clovers. Disk the minerals into the soil.

The secret of plenty of good pasture is allowing plenty of land, plenty of minerals, along with good preparation followed by good management.

Backtracking

(*From page* 5)

the Midwest did not savvy the systems advocated by this California prophet. But it kept the soup stirred just the same.

AS THE aforesaid national conference met, two chaps came from the Mississippi Valley with fire in their eyes. These men had been trying to make and sell a line of good farm machinery at Moline. The implements were all right and the farmers liked to use them, but hard times and distress prevented that "fair exchange value" that any red-blooded guy must have to keep on producing and keep on buying.

Beset with credit bothers resulting from just this stalemate, these two manufacturers of plows and harrows began to study ways and means of fixing things to enable willing farmers to dare risk their investment in bumper food production. Unless they found a way to untangle this twisted mess, farm machinery warehouses would be too full for comfort and dealers would quit business.

Instead of blasting their ideas into the stubborn and conservative conference going on, these two men wheedled cabinet members and the farm bloc contingent into listening to their proposals. So in a long series of executive sessions largely devoid of newspaper eavesdropping, George N. Peek and General Hugh S. Johnson laid their case before some sympathetic minds. Later some economists took a look at the implement men's program, and the first drafts of proposed laws to sketch out their dreams were written in the Department of Agriculture in 1923. Most of this backstage stuff went on with less fanfare and whooptedoo than would be possible today, when most newshawks scent a keen story in every angry farm confab.

All that need be said further regarding the Peek-Johnson-Wallace brain child is that the gist of its conception of remedies for stagnant agriculture was embodied in successive drafts of the laws enacted and then vetoed by President Coolidge. As everybody knows, the Congressional godfathers were Senator Charles L. McNary of Oregon and Representative Gilbert N. Haugen of Iowa. Possibly this original brief foreshadowing McNary-Haugen bills, as presented to the Farm Bureau by Peek & Johnson, may yet become a sort of Magna Charta to indicate a buried past in farm economics and the dawn of an entirely new commercial phase of farming.

ABOUT a decade later I was associated with many of the men who supported movements of a "radical" nature in regard to changing agriculture. The list includes both George Peek and Hugh Johnson (AAA and NRA chiefs, respectively) as well as Charles J. Brand, M. L. Wilson, Chester Davis, and the second Secretary Wallace. Indeed in the days just referred to, almost all farm folks had become somewhat "radical," because any kind of action was far better than taking it on the chin while lying down. Washington was full of foment and lather, and the government was the court of last resort. It was the last place of mutual faith, next to Heaven and the Promised Land, and everybody and his brother who were in trouble rushed to the banks of the Potomac—where nothing was "quiet."

The McNary-Haugen bills really outlined a minimum of real interference with existing agencies and aimed only at the separation of exportable crop surpluses so as to bring domestic farm income in line with a ratio of fair exchange value. Operations, as the bills proposed, were to be self-financed by collection of an equalization fee levied upon the first sale by farmers or the first processing of the various commodities named.

Support for these principles gained headway slowly and was most noticeable within the inner circle of the Department of Agriculture and the farm bloc. Opposition to any new drive for a different deal in meeting a farm crisis came from the agricultural colleges, old-line economists, and the industrial East as a body. Gradually, strength in support of positive action along new pathways developed among the state units of farm organizations and finally took form in the national conventions of those groups.

However, even the proponents of this departure from customary legislation did not see everything as clearly as they might. No effective protest came from the "radical" farm leaders sufficiently strong to prevent the enactment of the injurious tariff laws of 1929. The rates still further aggravated

the isolated situation of this country just at a time when we had become the world's biggest money lender and source of handouts galore.

LATER during the period when the Agricultural Adjustment Administration was taking shape, I heard some of these same leaders explain that the funds to be raised by processing taxes to pay farm benefits were merely a form of protective tariff for agriculture. No move was made then or during a few subsequent years by New Deal farm spokesmen to modify the tariff wall, until the theory of reciprocal trade agreements bobbed up. Even the use of Section 32 revenues from parts of the import duties as a means of "dumping" surplus was adhered to.

During the ferments of 1924-28, the gains made by legislation mostly amounted to the Capper-Volstead law to clear cooperatives of risks under antitrust lawsuits, and the Federal Intermediate Credit Act which did not fully meet the pressing short-term credit needs of agriculture.

SOME crazy-cat bills held the limelight awhile, too. From the desperate spring wheat belt came the proposal to use Federal funds to encourage and assist grain growers of the plains to shift over into dairying—the stability of the "cow, the hog, and the hen" being laid before many audiences meanwhile. A national conference was called in 1924 to give this thing an airing, with the thought that diversification should be subsidized. This and the hiking of the wheat tariff by the President by 12 cents a bushel accomplished simply zero, with all that such temperature means.

Guiding the thought and seeking the legislation of the times were the American Council of Agriculture, set up at St. Paul in a session many of us scribes attended, and the Executive Committee of Twenty-Two, created at a governors' council of farming states, who deliberated in Des Moines in January 1926. That year also marked new unity between the West and the South, crystallized at a Memphis convention. The late Frank O. Lowden of Illinois favored giving a free hand to cooperatives in achievement of farm salvation. This idea was not acceptable to the American Council of Agriculture folks, who felt at least that co-ops would not be able to maintain a fair price level at home and also handle exportable surplus. Meanwhile, the axe of adversity had cut handsome nicks in the dairy income, too, and the boys who had called for a shift from wheat to milk at government expense took a red-faced bow.

Just when things got thickest the fair-haired city slickers took a valiant hand. They were accompanied in their flights of oratory by some Land-Grant college pronouncements, none of which struck oil.

So in 1926 the ultra-conservatives awoke to the end of their gamble on reviving farming by doing nothing. They published a neat little red-covered book on the Agricultural Problem in the United States, replete with graphs and charts and sermonizing. The report was financed by the United States Chamber of Commerce and the National Industrial Conference Board, all of which had its purpose because it lent strength to some kind of action even if the first attempt did not pan out perfectly.

To make a long story shorter, the Agricultural Marketing Act of 1929 became effective, just on the eve of the great panic in stocks. By its terms the Federal Farm Board undertook to encourage cooperative marketing associations and set up stabilization corporations owned by them. To unify the process with Federal loans, the Board had a revolving fund at its disposal amounting to half a billion dollars (just a little more than the potato crop support price deal has cost since then).

So heavy were the eventual losses taken by the Board through accumulated surplus in cooperative storages

under their protecting wing that some of the members insisted that gains secured by withholding surplus supplies from the open market could be realized only in case farm production could be held down in line with actual home and foreign demand. But foreign loans had ceased and the export outlets were nil.

Dovetailing into this bitter but valuable experience was the conception by a small group of folks of what was then called the "domestic allotment plan." Chief sponsors of it were Chester Davis, John D. Black of Harvard, M. L. Wilson, now Director of Extension, and W. J. Spillman, an old employe of the Department of Agriculture. It bore no direct fruit itself as such but had much to do with the terms written into the 1933 version of the Agricultural Adjustment Act. Just a phrase or two is all the space available to explain it here:

THE part of the crop which farmers could sell in the domestic market was called the "domestic allotment," on which they were to receive certificates covering the full amount of their own share. To move any commodity into domestic consumption, processors must cover the amounts offered for sale to them with certificates bought from the farmers. The increased return was to result from the fact that the producer got the world price plus the proceeds from the sale of his certificates. Later on the Hope-Norbeck bill of 1932 cut out the certificates and provided for cash benefit payments to be realized by means of a processing tax, with limitation required on production within the domestic allotment figure.

Experience under the Agricultural Adjustment Act and the Hoosac Mills case decision that outlawed processing taxes led to the makeshift patchwork piece known as the Soil Conservation and Domestic Allotment Act of 1938. Conditional payments took the place of benefits and direct money from the Federal treasury replaced the processing taxes. Right here there appears a new angle to the whole farm-and-government relationship. Direct personal payments made from the public treasury in large volume to a class of citizens for special reasons of public welfare became established on statute books and bolstered by precedent.

Out of this has come much of the dither and doubt we face. Principles and justice are one thing and ways to bring them to pass with no harm to either consumers or producers are another thing. How to make it possible for farmers to dare to produce abundantly and produce the proper kinds of foods most needed without having things get lopsided or clear out of control is still a $64 question and will be for some time.

The principle of making direct treasury payments has been established, but in 1946 records show that farm cash income from marketings far outweighed all the government largesse then extended. That is, for every $24 of farm income last year only about 85 cents came in the form of direct individual payments from the treasury. To be sure, the other less direct government aid came through loans and support price operations under the Steagall Amendment. That these are far from fool-proof and that they often work hardships on segments of the farm industry beyond any benefits accruing to the ones that are most adaptable have been clearly stated in recent reports. Of course, the parity formula is the hurdle to be surmounted. It's what makes for this inequality.

IT'S QUEER, too, about subsidies. Originally, many of the farm spokesmen were against them, then gradually accepted them and even clamored for them. Few of these remain, it is true, but with some pressure of circumstances they could happen again.

Planned economy such as that which went awry in the potato salvage program this season and last could strike a blow at the heart of any well-con-

sidered, long-time approach to future stability. Meanwhile to blame it all on the unfortunate people obliged to carry on the details of some cumbersome project like that in the name of the government and to thereby encourage reckless speculation in food production by a class of non-farmers who let Uncle Sam hold the sack are, to say the least, demoralizing.

No, it is not all quiet on the Potomac yet. To be guilty of a pun, we still have "Hope," and as he and his colleagues think, so goes the Nation.

Ladies, Be Seated!

Two glamour girls boarded a crowded streetcar, and one of them whispered to the other: "Watch me embarrass a seat from one of the men!"

Pushing her way through the standees, she bore down on a gentleman who looked substantial and embarrassable.

"My dear Mr. Brown," she gushed loudly. "Fancy meeting you on the car. Am I glad to see you. Why you're almost a stranger. My I'm tired!"

The sedate gent looked up at the girl, whom he'd never seen in his life before, and as he rose, said pleasantly and for all to hear: "Sit down, Bertha, my girl. Don't often see you out on washday. No wonder you're tired. By the way, don't deliver the washing till Wednesday. My wife is going to the district attorney's office to see whether she can get your husband out of jail!"

Just Can't Happen

The Georgia election board was counting ballots. A Republican ticket showed up. Not finding anything wrong with it, the board put it aside as suspicious only. After several hours a second Republican ballot showed up. This was going too far. The judge said: "The son-of-a-gun voted twice. Throw 'em both out."

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VANITY FAIR

Small Boy: "Shine your shoes, Mister?"

Grouch: "No!"

Small Boy: "Shine your shoes so you can see your face in them?"

Grouch: "NO!"

Small Boy: "Coward!"

* * *

The actress married a director, longed for children and didn't have any. So she divorced him and married a producer.

* * *

SUPERSALESMAN

"Henderson is our best salesman—that guy could sell anything."

"That so?"

"Well, yesterday a widow came in to buy a suit in which to bury her husband, and he sold her one with two pairs of pants."

* * *

PROGRESS

Evolution of a man's ambition:
To be a circus clown.
To be like dad.
To be a fireman.
To do something noble.
To get wealthy.
To make ends meet.
To get the old-age pension.

* * *

There was a Romeo who said that he didn't care for his girl's bathing suit, and then added, "But outside of that she's all right."

With graceful feet, a maiden sweet was
tripping the light fantastic;
Then she suddenly tore for the dressing
room door—
You can't trust this wartime elastic.

* * *

DEFINITION

One wife to another: "My husband is an efficiency expert in a large office."

"What does an efficiency expert do?"

"Well, if we women did it, they'd call it nagging."

* * *

"I hear Marge broke up with Tom. Is she keeping those swell love letters he wrote her?"

"Well, yes and no. To be a little more exact, they're keeping her."

* * *

When a man says he's the boss in his family, he'll lie about other things, too.

* * *

MEANT IT TO LAST

A shy lad wanted to marry the girl, but he felt he would choke if he tried to mention the words, "marry" or "marriage" to her. So, after giving much thought to the problem, he asked her in a whisper one evening, "Julia, how would you like to be buried with my people?"

* * *

We heard a woman say that she felt better and looked younger, now that she was taking care of her feet instead of her face.

Need for—

BORON IN AGRICULTURE

Authorities have recognized that the depletion of Boron in soil has been reflected in limited production and poor quality of numerous field and fruit crops.

Outstanding results have been obtained with the application of Borax in specific quantities or as part of the regular fertilizer mix, improving the quality and increasing the production of alfalfa and other legumes, table beets, sugar beets, apples, etc.

The work of the State Agricultural Stations and recommendations of the County Agents are steadily increasing the recognition of the need for Boron in agriculture. We are prepared to render every practical assistance.

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The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

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Asparagus (General)
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Sweet Potatoes (General)
Better Corn (Midwest) and (Northeast)

Reprints

N-9 Problems of Feeding Cigarleaf Tobacco
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What Is the Matter with Your Soil?
H-12-42 Wartime Contribution of the American Potash Industry
H-2-43 Plant Food for Peach Profits
J-2-43 Maintaining Fertility When Growing Peanuts
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
FF-8-43 Potash for Citrus Crops in California
A-1-44 What's in That Fertilizer Bag?
H-2-44 Efficient Fertilizers for Potato Farms
AA-8-44 Florida Knows How to Fertilize Citrus
CC-8-44 Soil Fertility's Effect on Asparagus
QQ-12-44 Leaf Analysis—A Guide to Better Crops
P-3-45 Balanced Fertility in the Orchard
R-3-45 Higher Corn Yields for North Carolina
Z-5-45 Alfalfa—the Aristocrat
DD-5-45 A Case of Combined Potassium and Boron Deficiencies in Grapes
GG-6-45 Know Your Soil
LL-8-45 Fertilizing for Better Soybeans in North Carolina
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